FINAL REPORT
FEBRUARY 1991

REPORT NO. EVT 33-90

OPERATION DESERT STORM

ENVIRONMENTAL MONITORING OF AMMUNITION TEMPERATURES

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The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), monitored ammunition temperatures within Saudi Arabia (SA) for a period of approximately two months in support of Operation Desert Storm. The SMCAC-DEV data logger was installed on temperature sensitive munitions by instructors from USADACS, Nuclear Weapons Department (SMCAC-AST), detailed to SA. This test is the first in a series to ensure long-term reliability of fielded ammunition within SA. The following report contains test results of selected ammunition monitored during the 4th quarter of 1990 and represents the first feedback of temperature data from SA.

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

VALIDATION ENGINEERING DIVISION

SAVANNA, IL 61074-9639

REPORT NO. EVT 33-90

OPERATION DESERT STORM
ENVIRONMENTAL MONITORING OF AMMUNITION TEMPERATURES

TABLE OF CONTENTS

PART 1

INTRODUCTION

A. BACKGROUND. During early deployment of troops to Saudi Arabia (SA), the U.S. Army (USA), along with other services, was concerned about high temperatures having an adverse effect on stored ammunition. Long-term open storage monitoring programs were established within the USA. U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division, was assigned to instrument ammunition while U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Predictive Technology Branch, was assigned as program manager. Prior to procurement of needed instrumentation, USADACS used existing equipment to monitor ammunition within SA to get early feedback on ambient and ammunition temperatures. This is to be followed by long-term, more involved instrumentation projects with procured equipment. Long-term objectives of this program are to assure the recorded temperatures of which the ammunition is exposed does not exceed the design temperature limits which ensure safe, reliable ammunition.

B. AUTHORITY. These tests were conducted in accordance with mission responsibilities delegated by AMCCOM, Rock Island, IL.

C. OBJECTIVE. The primary objectives of temperature monitoring within SA include the following:

1. Determination of the maximum temperature ammunition is exposed to.

2. Adverse effects/degradation of ammunition after high temperature storage.

3. Methods of reducing exposure to temperatures through shielding.

4. Determination of critical components on fielded ammunition.

Realization of objectives will not be accomplished until laboratory testing and evaluation have been conducted to assess degradation of the tested items. This report contains a very small portion of the overall program.

PART 2

OPERATION DESERT STORM
ENVIRONMENTAL MONITORING OF AMMUNITION TEMPERATURES

TEST ATTENDEES

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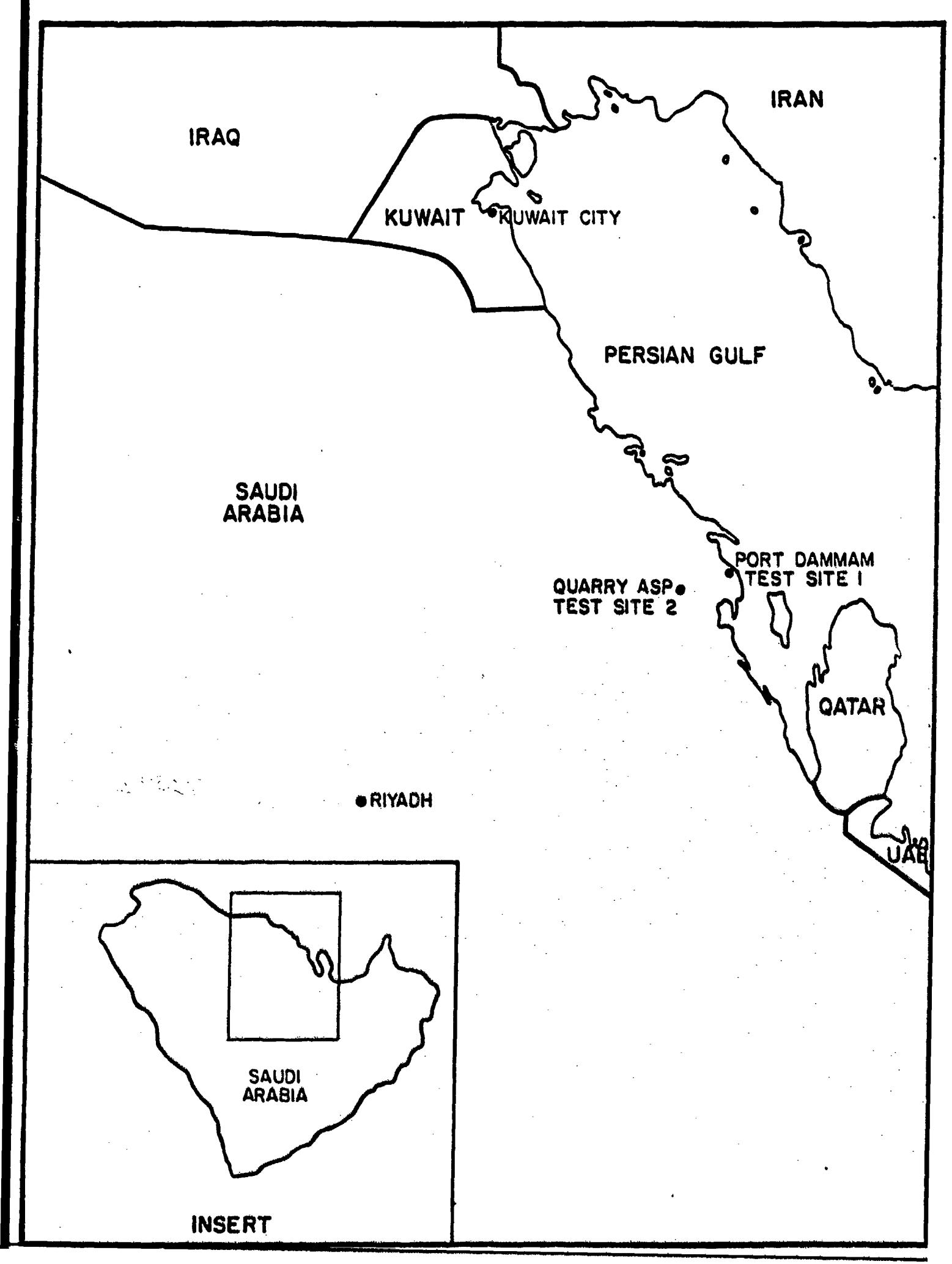
PART 3

TEST PROCEDURES

Test sites for instrumentation in SA are depicted on the enclosed map; i.e., Port Dammam (test site 1) and the Quarry Ammunition Supply Point (ASP) (test site 2). The Quarry ASP is located approximately 40 to 50 kilometers southwest of Dammam. Each of the test sites was instrumented as depicted in test site layouts 1-4 located in section 5 of this report. Each item to be monitored had thermistors adhered to the container's exterior walls as shown in the detailed pallet drawings 1-4 (also located in section 5). All data points were taken at 1-hour intervals for a minimum period of 48 hours. Instrumentation included at least one ambient temperature probe per each test site. The location of temperature measurement probes included direct exposure to the sun, intermediate layers within the pallet, as well as points of location between stacked pallets of ammunition. All test pallets were uncovered and exposed directly to the environment in SA.


IRAN
IRAQ
KUWAIT
KUWAIT CITY
PERSIAN GULF
SAUDI
ARABIA
PORT DAMMAM
TEST SITE 1
QUARRY ASP
TEST SITE 2
QATAR
RIYADH
UAE
SAUDI
ARABIA
INSERT

PART 4

TEST EQUIPMENT

A. DATA ACQUISITION SYSTEM

MANUFACTURER	Omega Engineering
MODEL NUMBER	OM-220
NUMBER OF CHANNELS	8
DURATION BETWEEN READINGS	1 Hour
TOTAL NUMBER OF READINGS	32,000

B. TEST ITEMS

ITEM: HELLFIRE MISSILE (AGM-114C)

NATIONAL STOCK NUMBER	1410-192-0293
DODIC	PD68
SERIAL NUMBER	606501
DRAWING	19-48-5250
WIDTH	46-1/2 Inches
LENGTH	76-1/4 Inches
HEIGHT	53 Inches
WEIGHT	1,661 Pounds

ITEM: HELLFIRE MISSILE (AGM-114A)

DODIC	PA79
DRAWING	19-48-5250-GM20HFI
WIDTH	46-1/2 inches
LENGTH	76-1/4 Inches
HEIGHT	53 Inches
WEIGHT	1,661 Pounds

ITEM: 155mm COPPERHEAD PROJECTILE

MODEL NUMBER	M712
DODIC	D510
DRAWING	19-48-4159-20PM1003
WIDTH	33 Inches
LENGTH	64 Inches
HEIGHT	27-1/2 Inches
WEIGHT	1,397 Pounds

ITEM: 155mm HE ADAM

MODEL NUMBER.....M731
DODIC.....D502
WIDTH.....43-7/8 Inches
LENGTH.....29-1/8 Inches
HEIGHT.....39-3/8 Inches
WEIGHT.....2,676 Pounds

ITEM: 155mm PROP CHARGE

LOT NUMBER.....IND82C-070018
LOT NUMBER.....IND83K-070319
DODIC.....D533
DRAWING.....19-48-4042A/9-20PM1001
WIDTH.....35-3/4 Inches
LENGTH.....52-1/2 Inches
HEIGHT.....49 Inches
WEIGHT.....1,452 Pounds

ITEM: PROXIMITY FUZE

MODEL NUMBER.....M732
DODIC.....N464
DRAWING.....19-48-4116/156G-20PA1002
WIDTH.....43-7/8 Inches
LENGTH.....51-1/4 Inches
HEIGHT.....31-5/8 Inches
WEIGHT.....1,902 Pounds

ITEM: MTSQ FUZE

MODEL NUMBER.....M577A1
DODIC.....N285
DRAWING.....19-48-4116/156-20PA1002
WIDTH.....51-1/4 Inches
LENGTH.....43-7/8 Inches
HEIGHT.....31-1/4 Inches
WEIGHT.....1,743 Pounds

PART 5

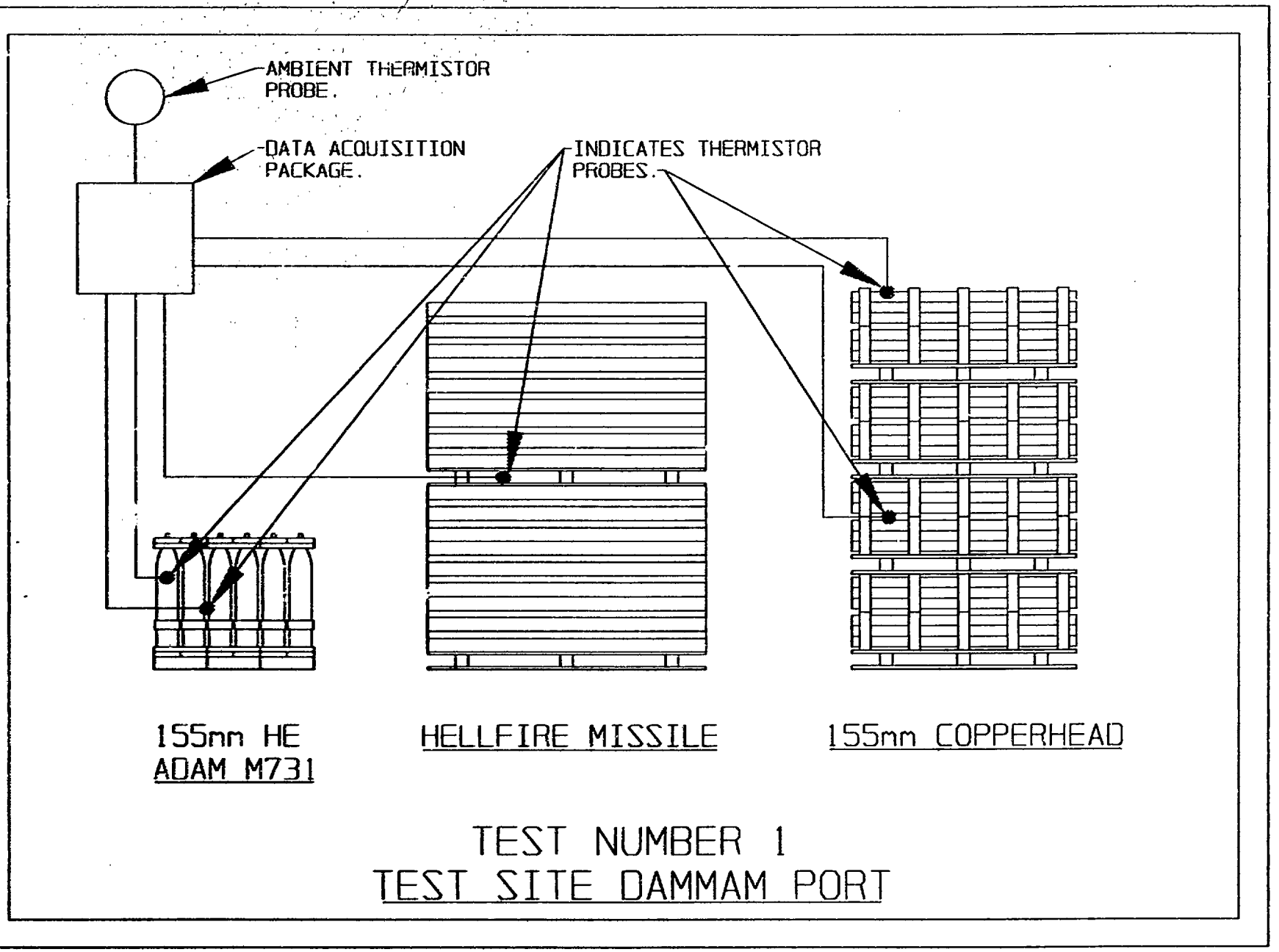
TEST RESULTS

A. TEST NO. 1:

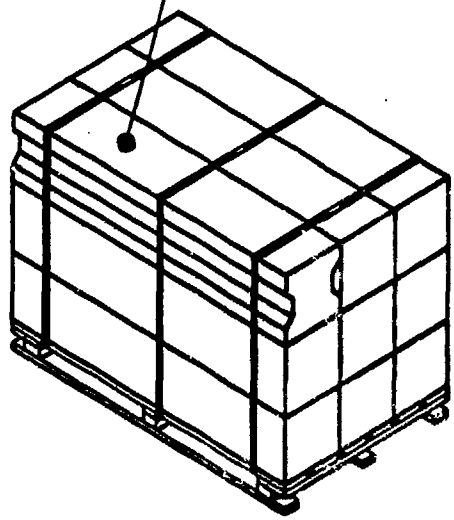
1. Tests were conducted at Dammam Port (the port of reception of ammunition into SA) during the timeframe 31 October - 2 November 1990. Test items included the 155mm Copperhead projectiles, Hellfire missile AGM-114A, and the 155mm HE ADAM projectiles (see page 5-4). As tested, the 155mm Copperhead projectiles were stacked four-high with temperature probes located on the top, exposed directly to solar radiation, and on the third pallet from the top, which was shaded from direct sunlight. The Hellfire missiles were stacked two-high with a temperature probe located between the pallet's skids. The 155mm HE ADAM projectiles were stacked one-high with a probe located on the projectiles' surface close to the lifting plug, and a second probe located approximately 1/3 of the way down from the top of the projectile.

2. During this test, peak ambient temperature was 89 degrees Fahrenheit while the 155mm projectiles reached a maximum temperature of 116 degrees Fahrenheit when exposed directly to the sun, and 94 degrees Fahrenheit for the shaded projectiles (see graphs 1 and 2). The 155mm Copperhead projectiles, when exposed to the sun, reached 110 degrees Fahrenheit while probes shaded between pallets reached a temperature of 86 degrees Fahrenheit, 3 degrees Fahrenheit below ambient (see graphs 3 and 4). During this test, the Hellfire missile reached a maximum temperature of 122 degrees Fahrenheit when exposed directly to the sun (see graph 5).

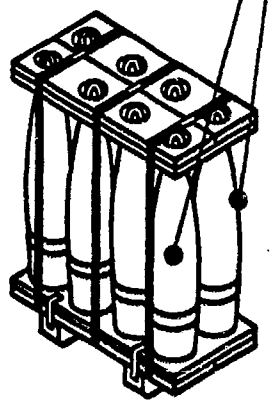
3. Test no. 1 indicated that although SA was entering its winter season, temperature differentials of 33 degrees over ambient were possible when ammunition was exposed directly to the sun; also, due to the cooler nights of approximately 75 degrees Fahrenheit, some ammunition remained below peak ambient temperature due to thermal lag and short duration of peak daytime temperatures. Different ammunition also received different maximum temperatures, most likely due to location of the probe and thermal mass.


AMBIENT THERMISTOR PROBE.
DATA ACQUISITION PACKAGE.
INDICATES THERMISTOR PROBES.
155mm HE ADAM M731
HELLFIRE MISSILE
155mm COPPERHEAD
TEST NUMBER 1
TEST SITE DAMMAM PORT

INDICATES LOCATION OF THERMISTOR PROBES

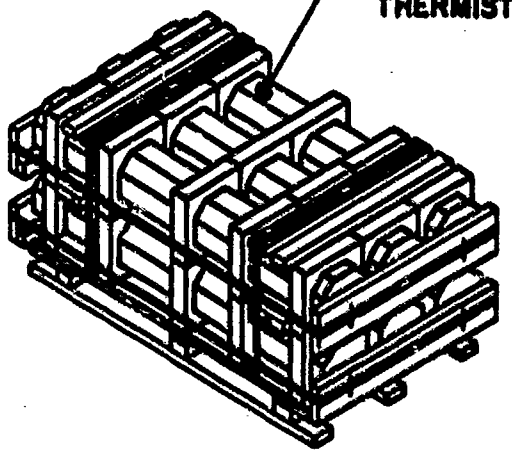


HELLFIRE MISSILE



155 MM HE
ADAM M731

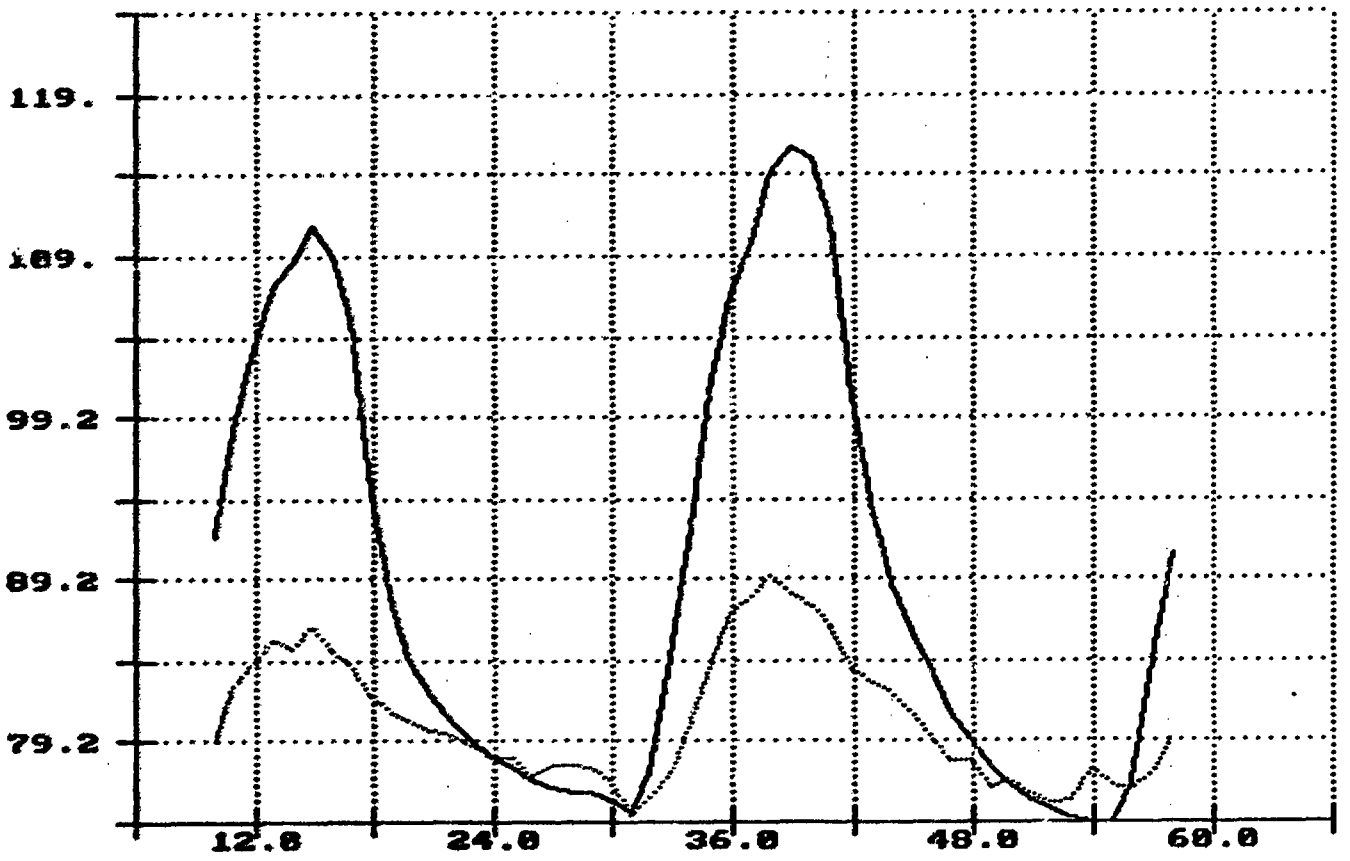
INDICATES LOCATION OF THERMISTOR PROBE



155 MM COPPERHEAD

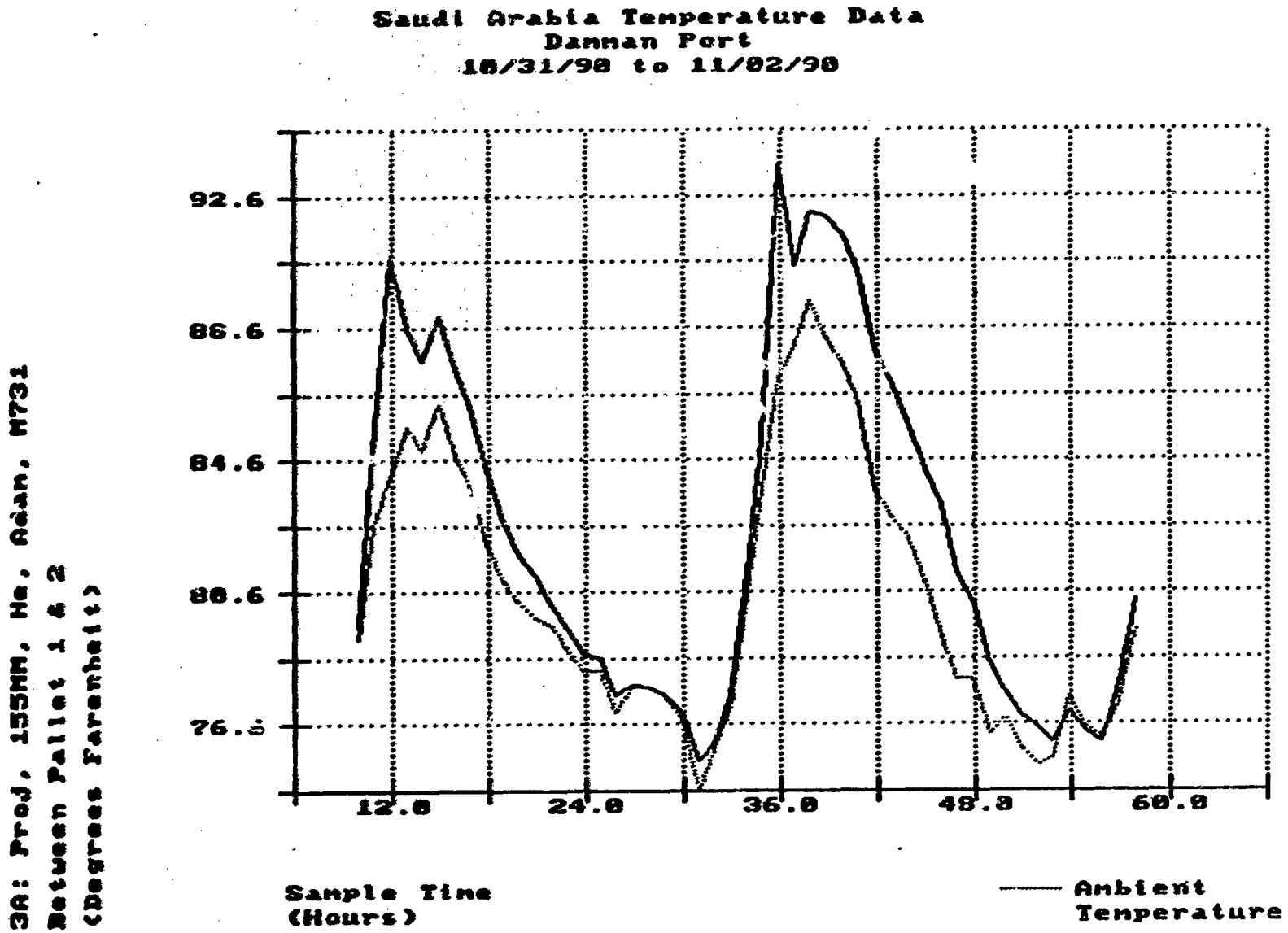
DRAFTSMAN TRS	TITLE TEST No. 1 TEST SITE DAMMAM PORT
TEST ENGINEER	
CHIEF, VALIDATION ENGINEERING DIVISION	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL, SAVANNA, ILLINOIS 61074-9639

Saudi Arabia Temperature Data
Dannan Port
10/31/90 to 11/02/90

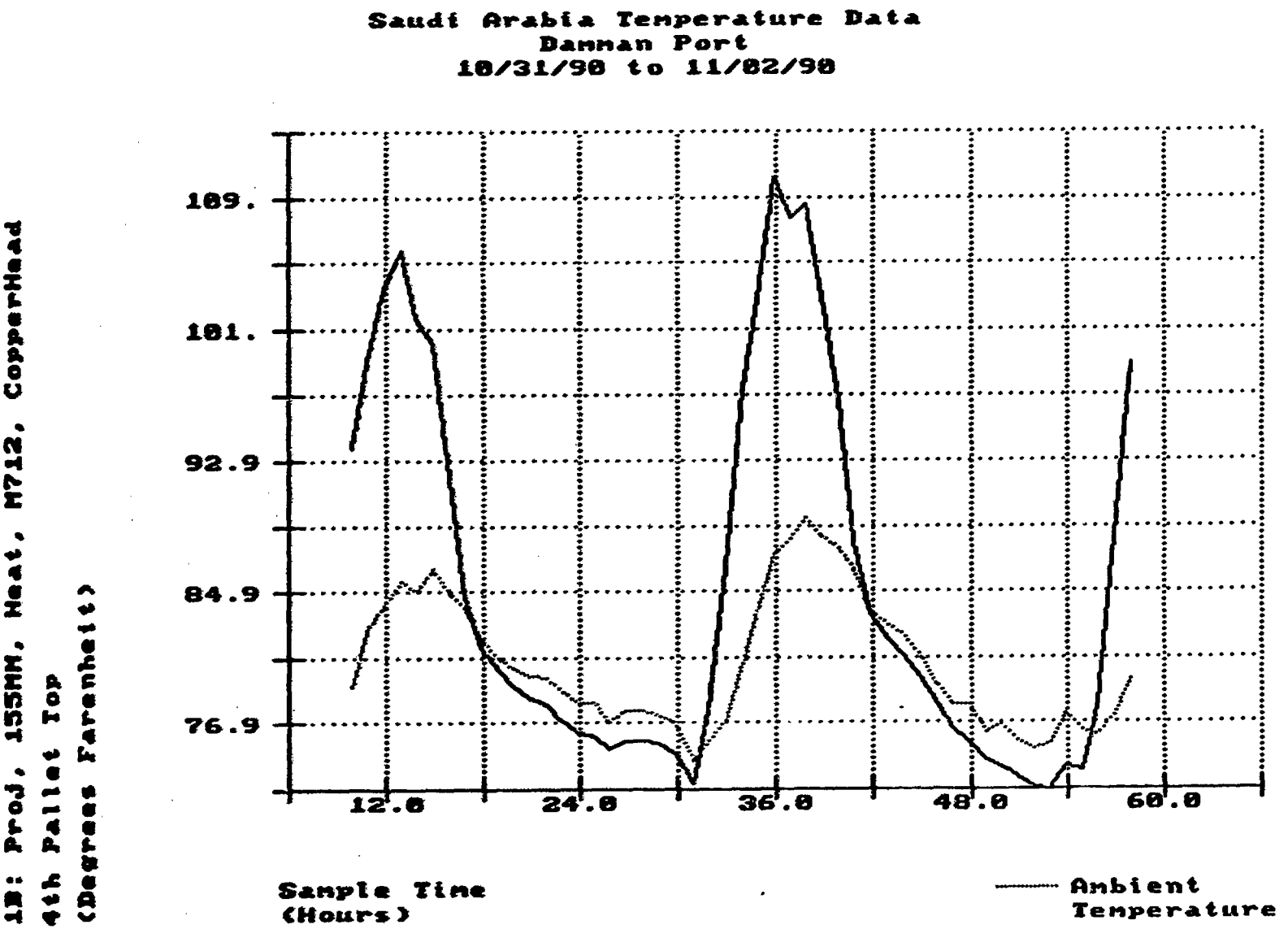


3B: Proj. 155MM, He, Adan, M731
Front Side, Pallet 1
(Degrees Farenheit)

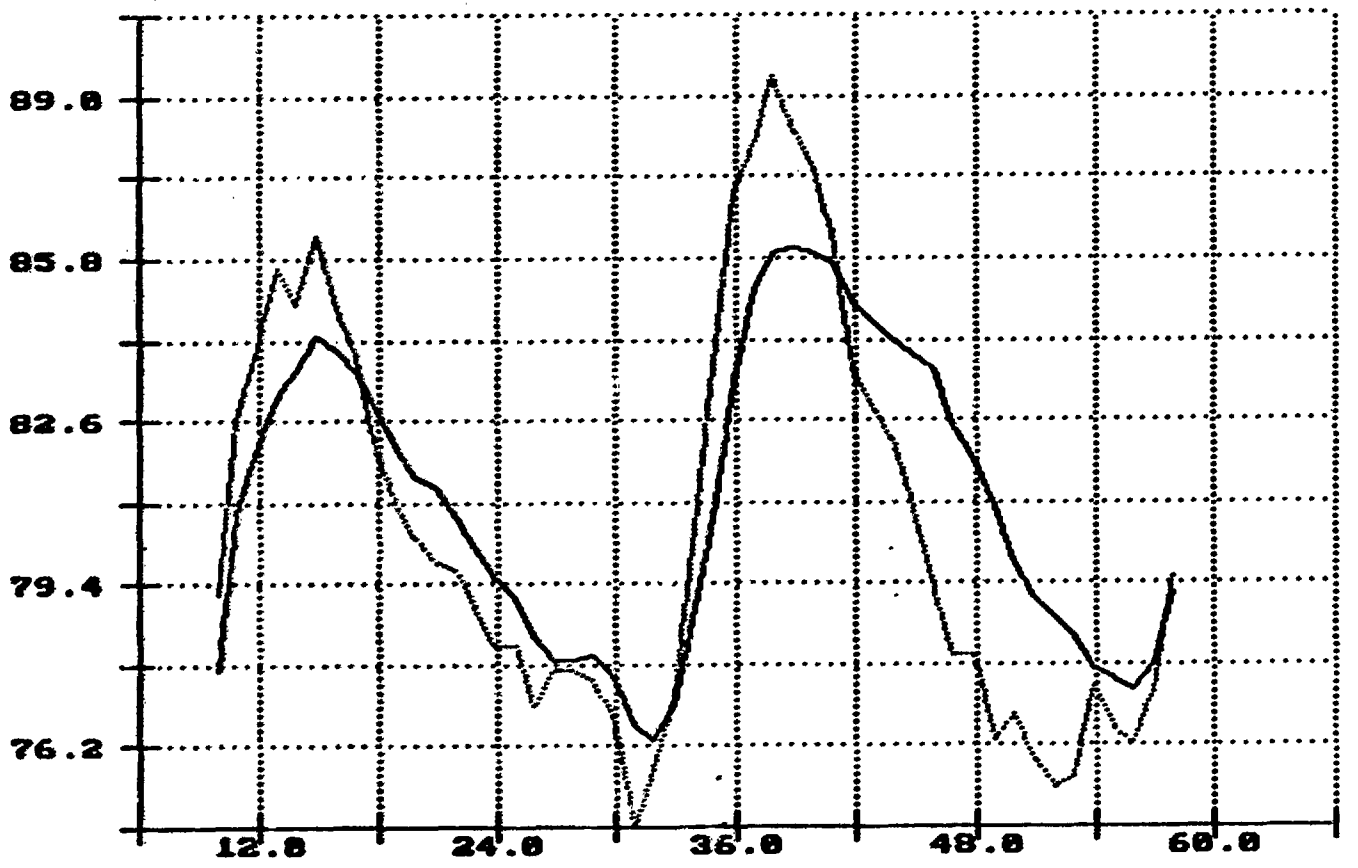
Graph 1


Saudi Arabia Temperature Data
Dammam Port
10/31/90 to 11/02/90
92.6
86.6
84.6
80.6
76.6
12.0
24.0
36.0
48.0
60.0
Sample Time
(Hours)
Ambient
Temperature
3A: Proj. 155MM, Hq. Adan, M731
Between Pallet 1 & 2
(Degrees Farenheit)

Graph 2

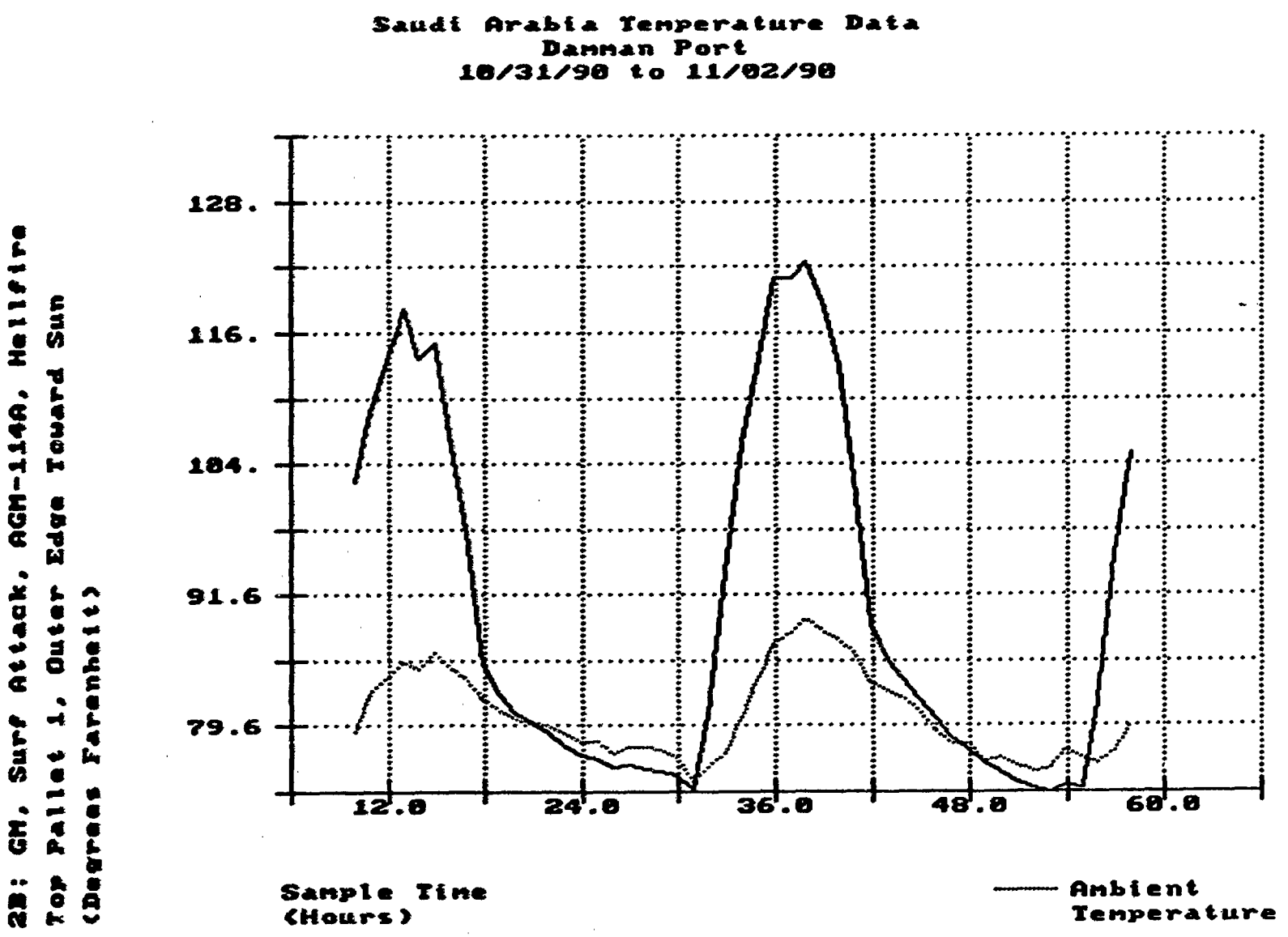

Saudi Arabia Temperature Data
Damman Port
10/31/90 to 11/02/90
109.
101.
92.9
84.9
76.9
12.0
24.0
36.0
48.0
60.0
Sample Time
(Hours)
Ambient
Temperature
1B: Proj. 155MM, Heat, M712, CopperHead
4th Pallet Top
(Degrees Farenheit)

Saudi Arabia Temperature Data
Damman Port
10/31/98 to 11/02/98



2A: Proj. 155MM, Heat, M712, CopperHead
2nd Pallet, Between 1st & 2nd Layer, Middle
(Degrees Farenheit)

Graph 4


Saudi Arabia Temperature Data
Damman Port
10/31/90 to 11/02/90
2B: GM, Surf Attack, AGM-114A, Hellfire
Top Pallet 1, Outer Edge Toward Sun
(Degrees Farenheit)
128.
116.
104.
91.6
79.6
12.0
24.0
36.0
48.0
60.0
Sample Time
(Hours)
Ambient
Temperature

Graph 5

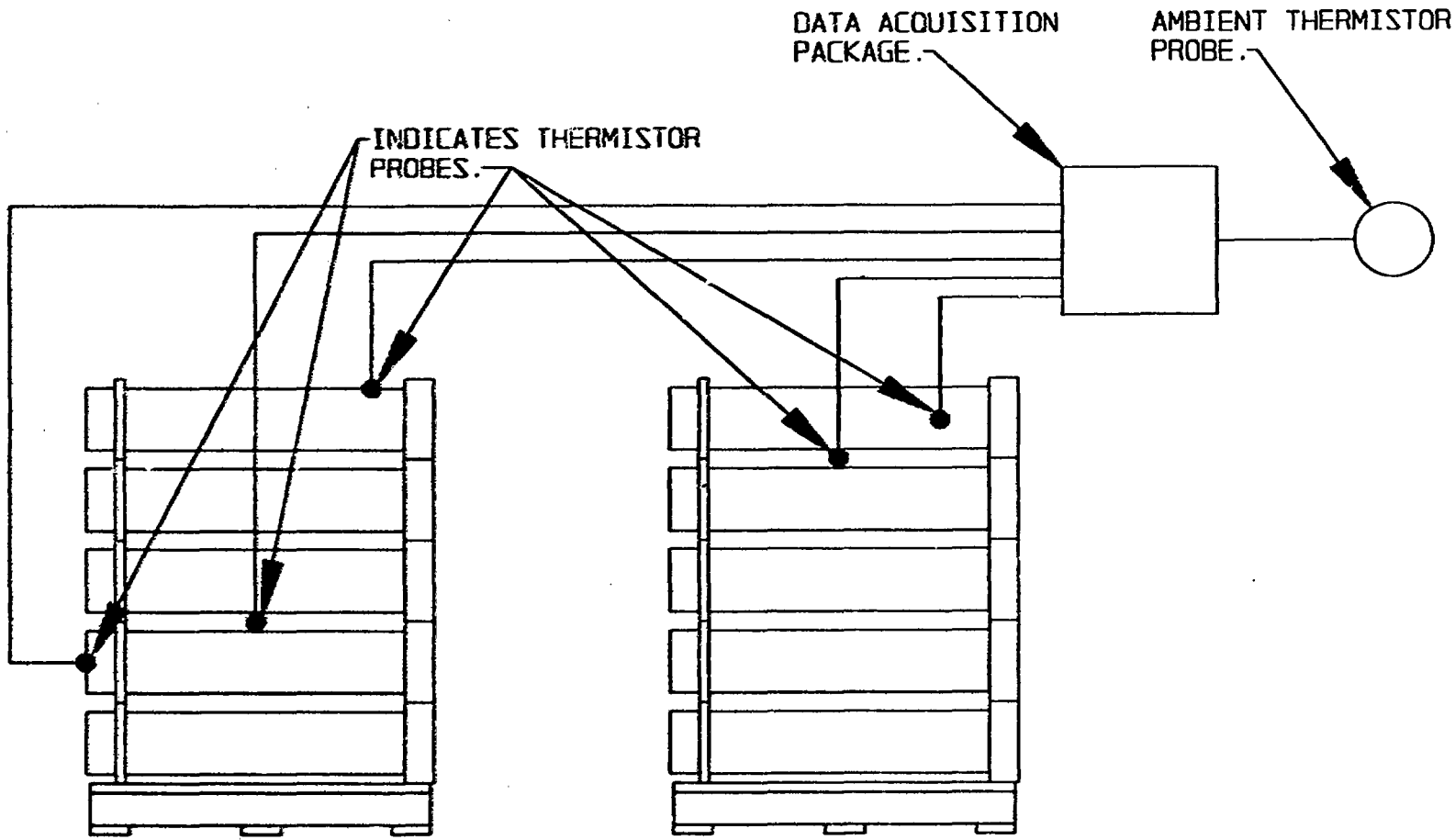
TEST RESULTS

B. TEST NO. 2:

1. This test was conducted at the Quarry ASP, which is located 40 - 50 kilometers southwest of the Port of Dammam, from 7-12 November 1990 on two different lots of 155mm propelling charges. The 155mm projectiles were stacked one pallet high on pad no. A07. During this test, temperature probes were located on top of the pallet as well as midway between layers (see page 5-12 for location of details).

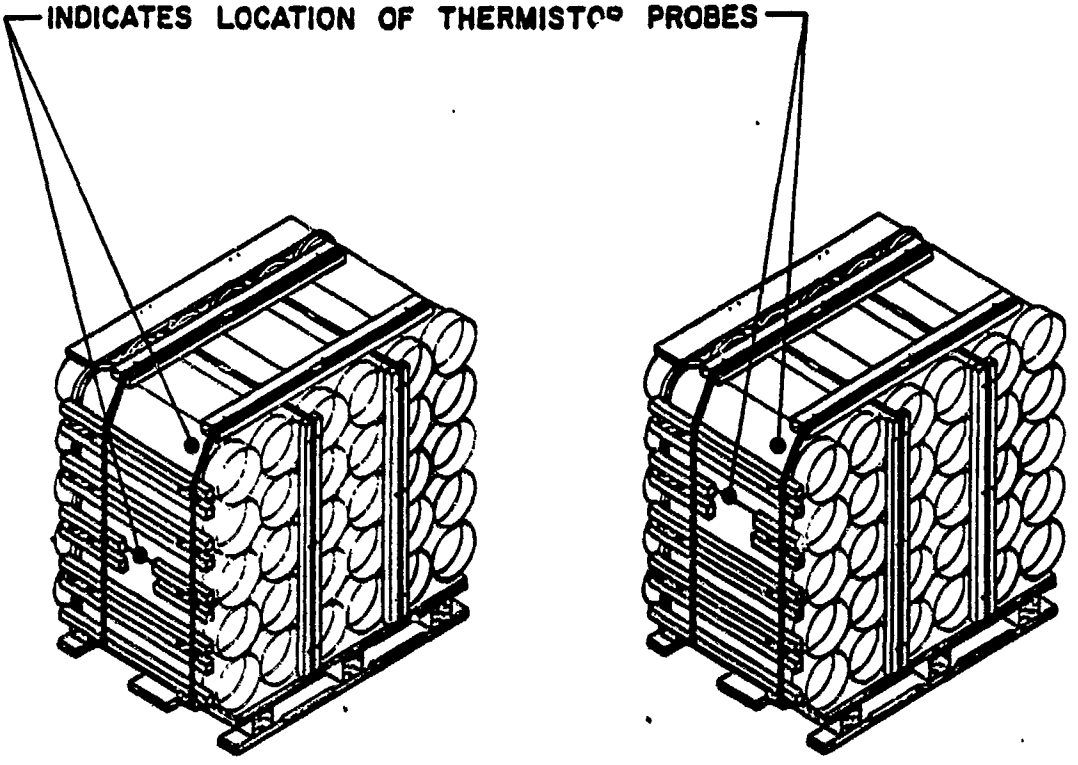
2. Peak ambient temperature reached 96 degrees Fahrenheit while the top of the pallet reached 119 degrees Fahrenheit, and the side of the pallet facing the sun reached 123 degrees Fahrenheit (see graphs 6 and 7). Shaded interior probes remained very close to ambient with the maximum temperature reaching approximately 98 degrees Fahrenheit (see graphs 8, 9, and 10).

3. This test demonstrated that outer layers (top and sides) exposed directly to sunlight have the highest potential for heat damage. Containers shaded by outer layers within the unit load remained cool and very close to ambient. Very little heat transfer from outer to inner layers was noted, primarily due to the air space between adjacent layers (air being a poor heat transfer medium).



155mm PROP CHARGE

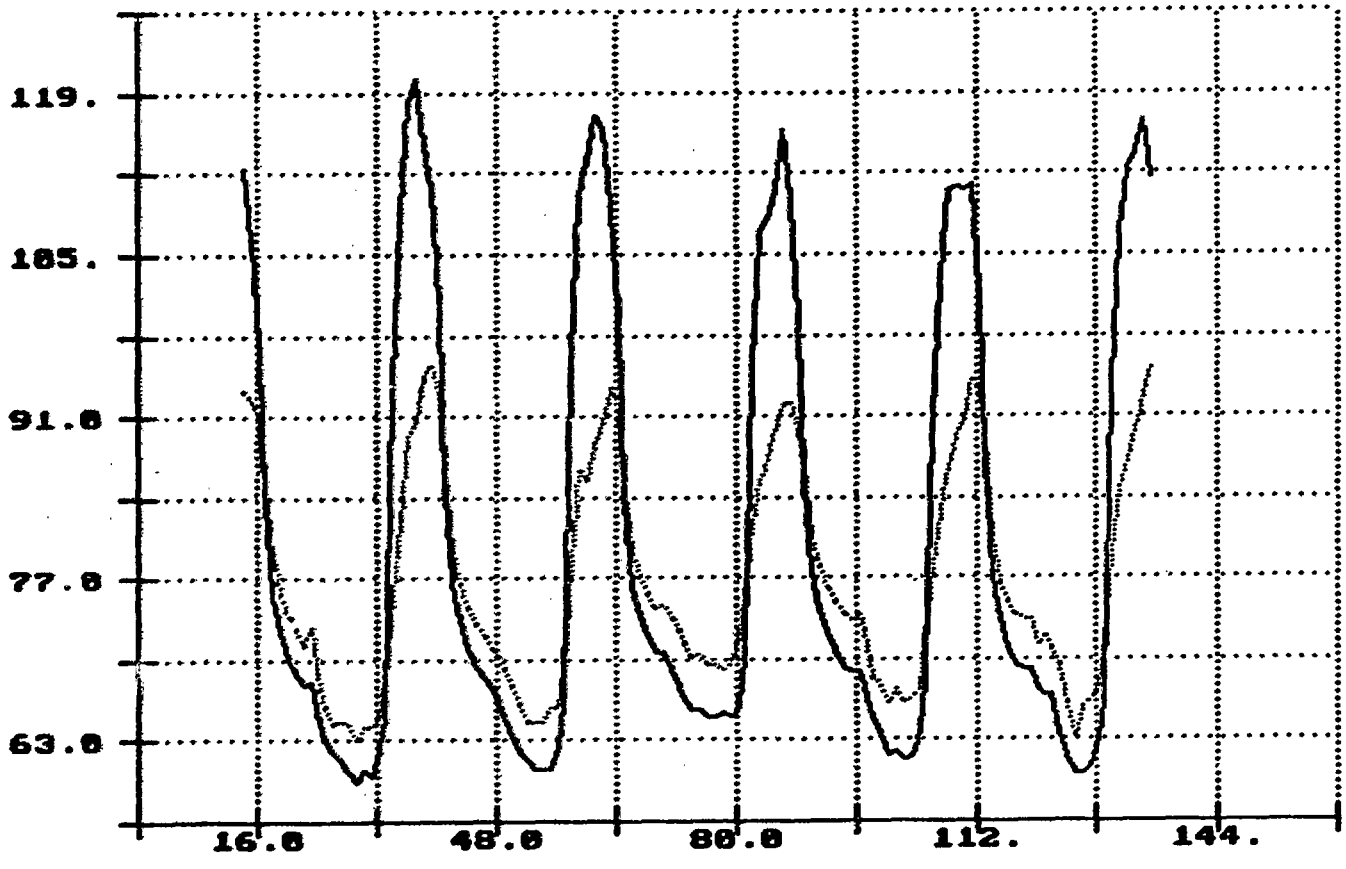
TEST NUMBER 2
TEST SITE TSA #1 QUARRY



155 MM PROP CHARGE

DRAFTSMAN TRS	TITLE TEST No. 2 TEST SITE TSA No. 1 QUARRY
TEST ENGINEER	
CHIEF, VALIDATION ENGINEERING DIVISION	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL, SAVANNA, ILLINOIS 61074-9639

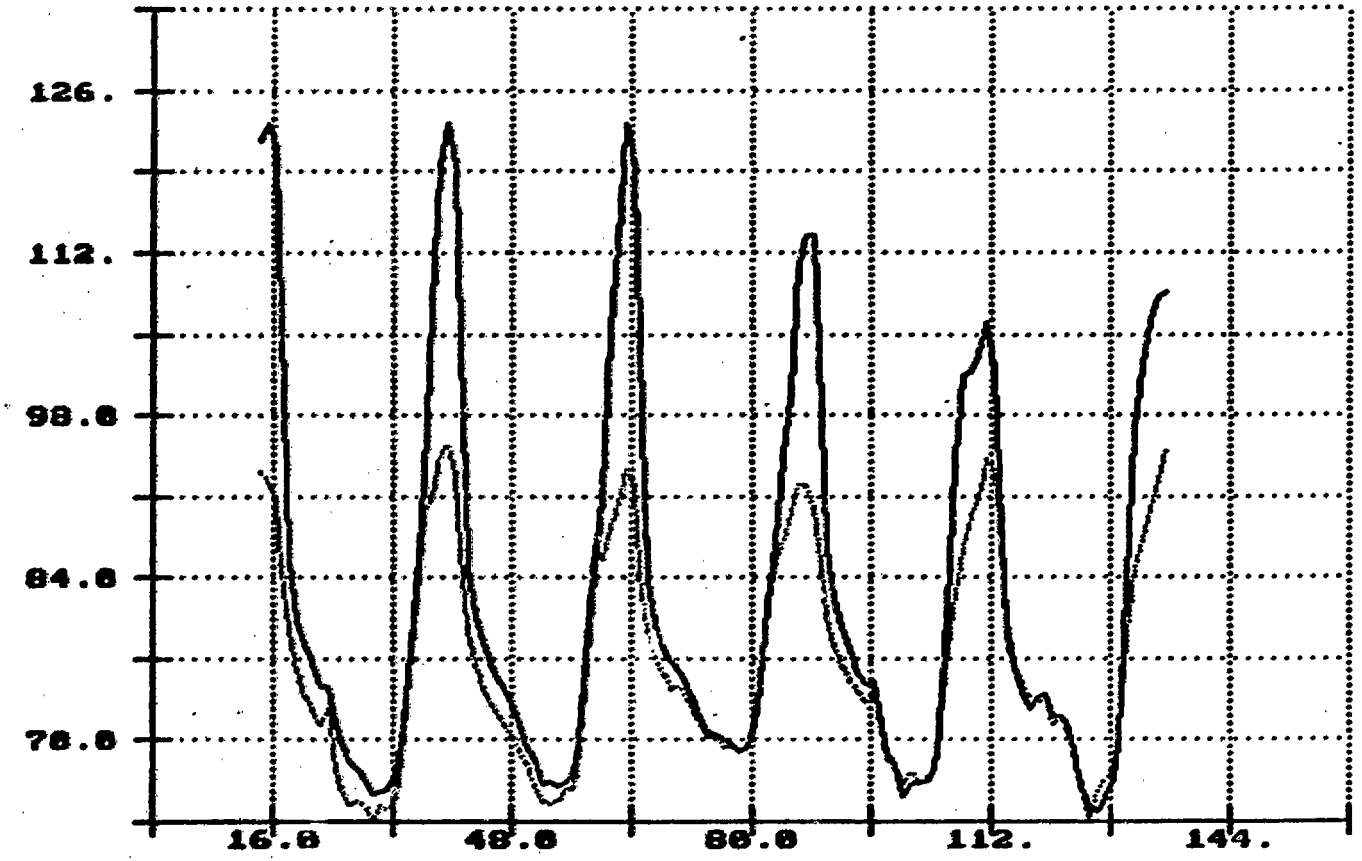
Saudi Arabia Temperature Data
TSA #1 Quarry Pad A07
11/07/90 to 11/12/90



1B: 155MM Prop Charges, IND83X-070319
Pallet Top
(Degrees Farenheit)

Graph 6

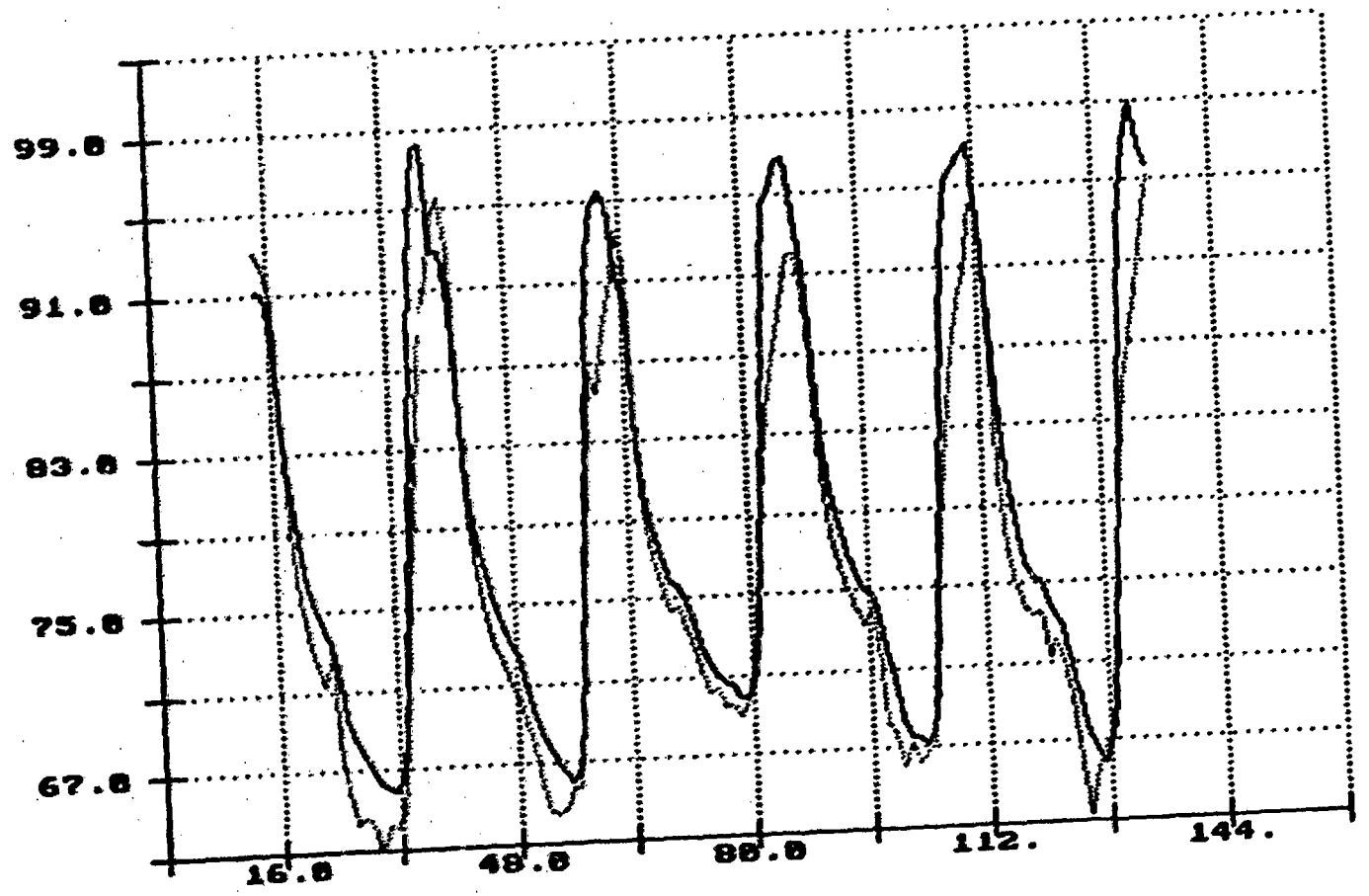
Saudi Arabia Temperature Data
ISA #1 Quarry Pad A07
11/07/90 to 11/12/90



33: 155MM Prop Charges, IND82C-870018
Outside
(Degrees Farenheit)

Graph 7

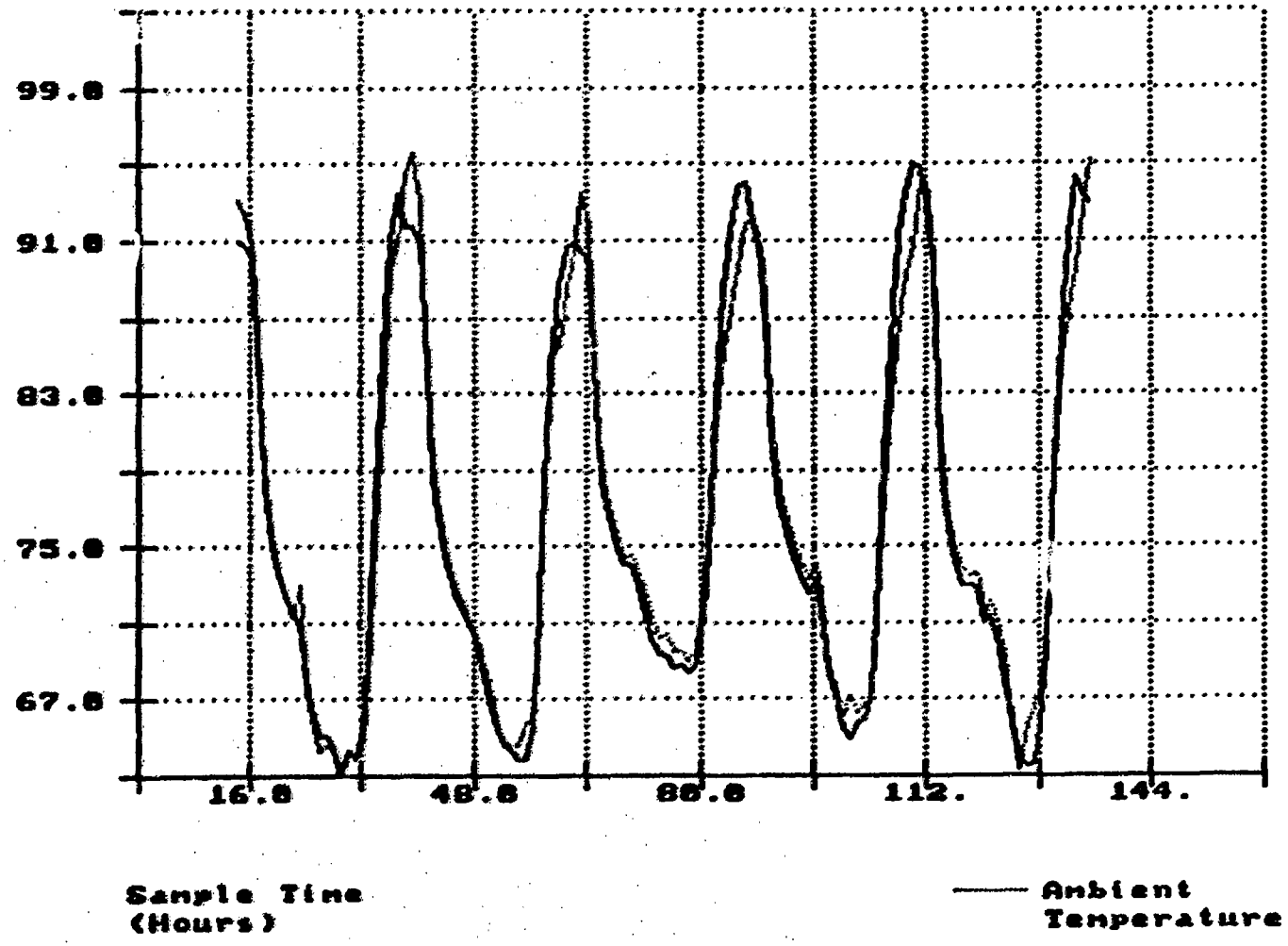
Saudi Arabia Temperature Data
TSA #1 Quarry Pad A07
11/07/98 to 11/12/98



2A: 155MM Prop Charges, IND83X-870319
Pallet Interior Between 2nd & 3rd Row
(Degrees Farenheit)

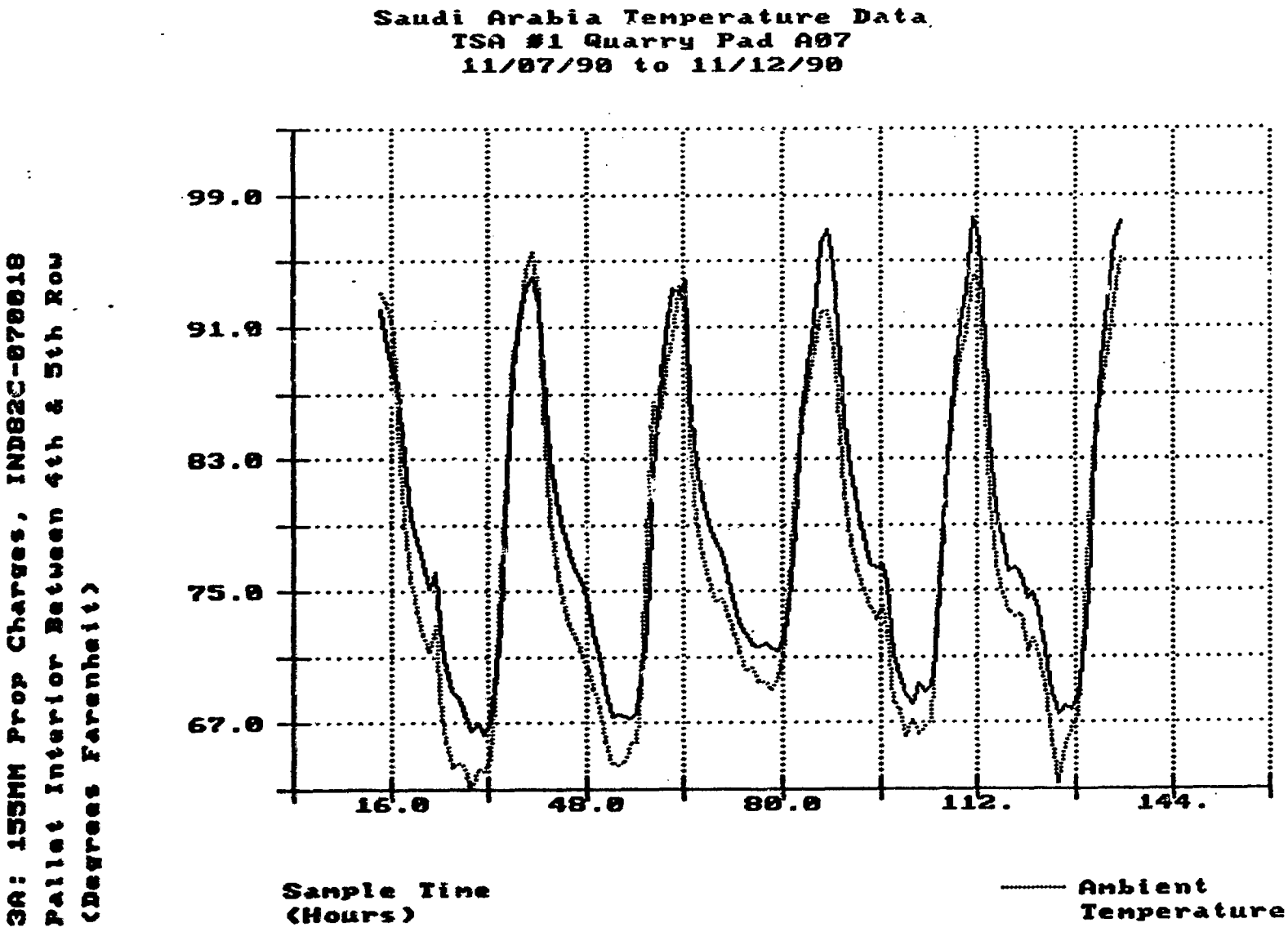
Graph 8

Saudi Arabia Temperature Data
TSA #1 Quarry Pad A07
11/07/90 to 11/12/90



2B: 155MM Prop Charges, INDB3K-870319
Pallet End, 2nd Row, Towards Sun
(Degrees Farenheit)

Graph 9



3A: 155MM Prop Charges, IND82C-070018
Pallet Interior Between 4th & 5th Row
(Degrees Farenheit)

Graph 10

TEST RESULTS

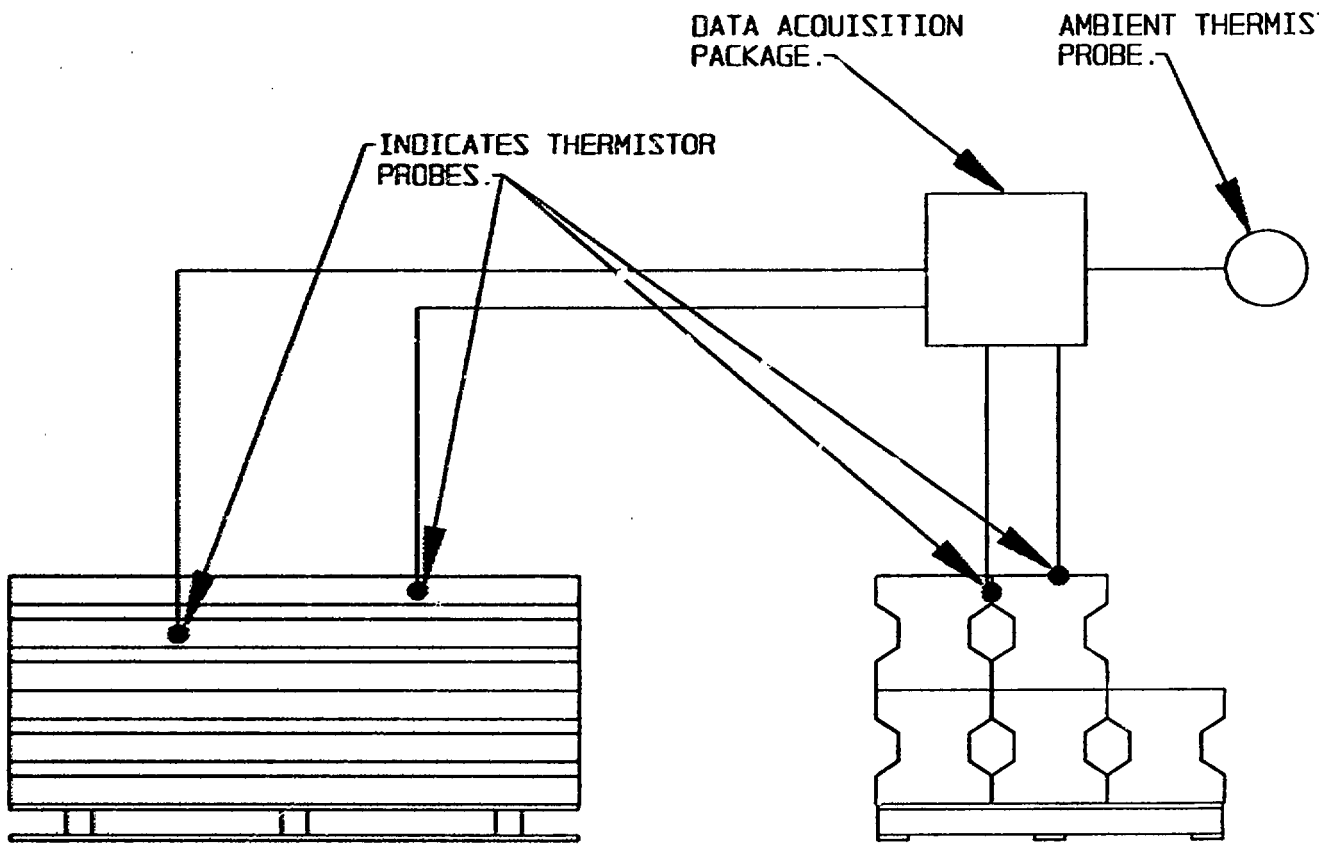
C. TEST NO. 3:

1. This test was conducted 12-23 November 1990 on pad no. 017 at the Quarry ASP. The test was conducted on one pallet of Hellfire missiles (AGM-114C). Test probes were placed on the top containers, which were exposed directly to the sun; also, three shaded probes were placed between shipping containers and on the sides (see page 5-21 for details).

2. This test lasted 11 days with the peak ambient temperature reaching 90 degrees Fahrenheit for a short period of time while the probe between the containers only reached 95 degrees Fahrenheit. The two probes positioned fore and aft on the container's shaded sides reached 95 degrees Fahrenheit and 102 degrees Fahrenheit, respectfully, and were shaded. On the ninth day of testing, ambient temperature was only 82 degrees Fahrenheit; however, the top of the pallet approached 113 degrees Fahrenheit with all other surface probes remaining between 90 - 95 degrees Fahrenheit (see graphs 11 - 14).

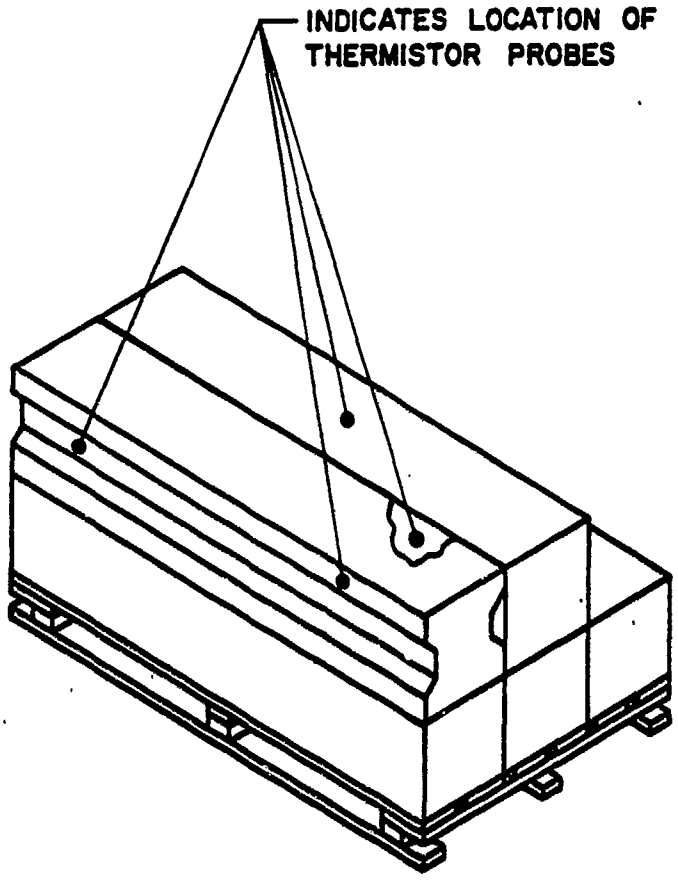
3. During this test, the surface skin temperature of the container was exposed directly to the sun and was not directly dependent on ambient temperature. For instance, on the second day of testing, the container skin reached 115 degrees Fahrenheit while ambient temperature was 90 degrees Fahrenheit, or a 25 degree Fahrenheit differential. On the ninth day, the skin temperature approached 113 degrees Fahrenheit while the ambient temperature was 82 degrees Fahrenheit, or a temperature differential of 31 degrees Fahrenheit. This variation in temperature differential is due to cloud cover, length of exposure to direct sunlight, air purity (amount of particulate in the air), and wind speed, to name a few. These uncontrollable

variables make direct correlation between ambient temperature and skin temperature impossible. Indirect correlation may be derived with a window (range) of expected surface temperatures.



HELLFIRE MISSILE

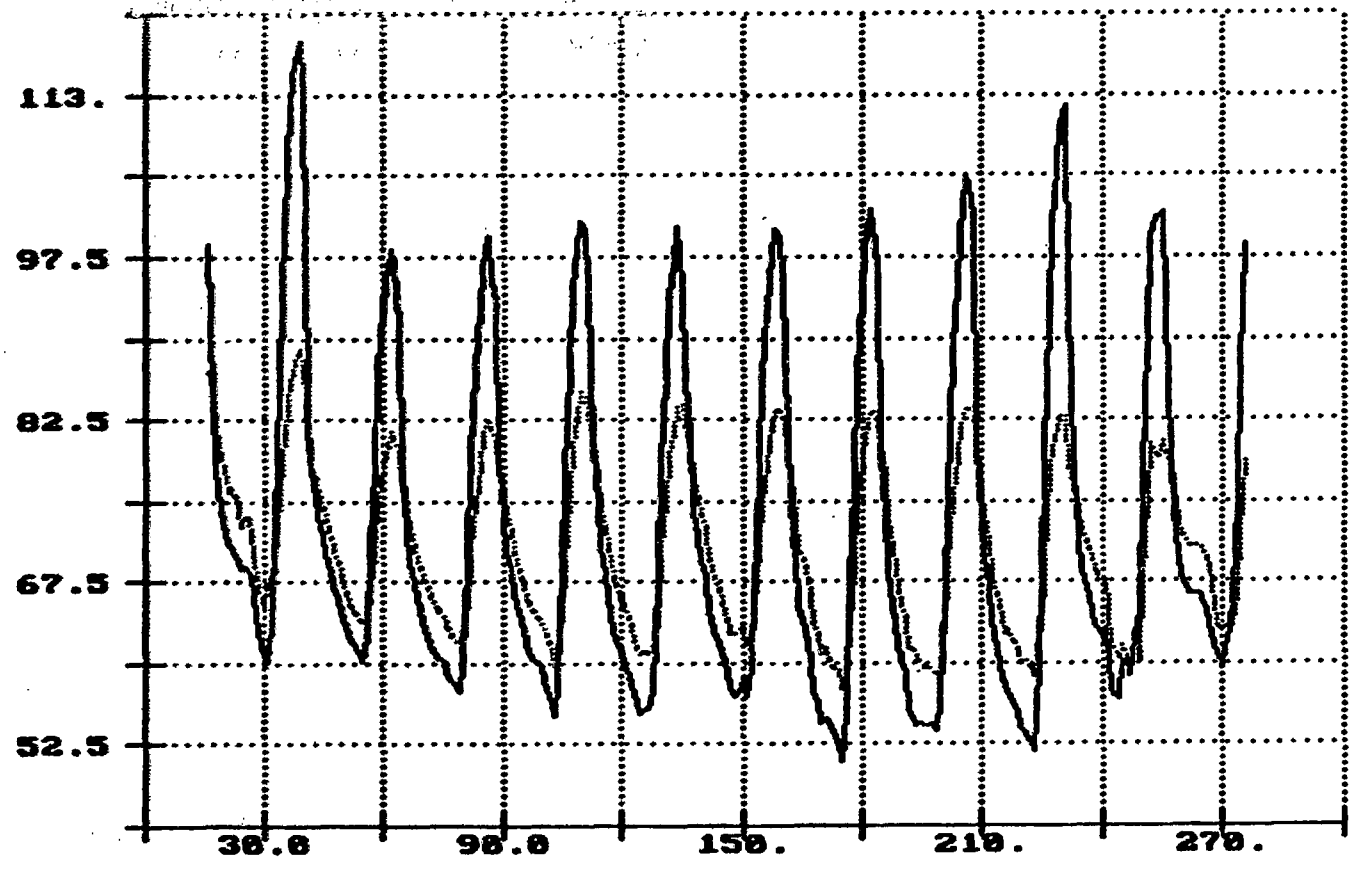
TEST NUMBER 3
TEST SITE TSA #1 QUARRY



HELLFIRE MISSILE

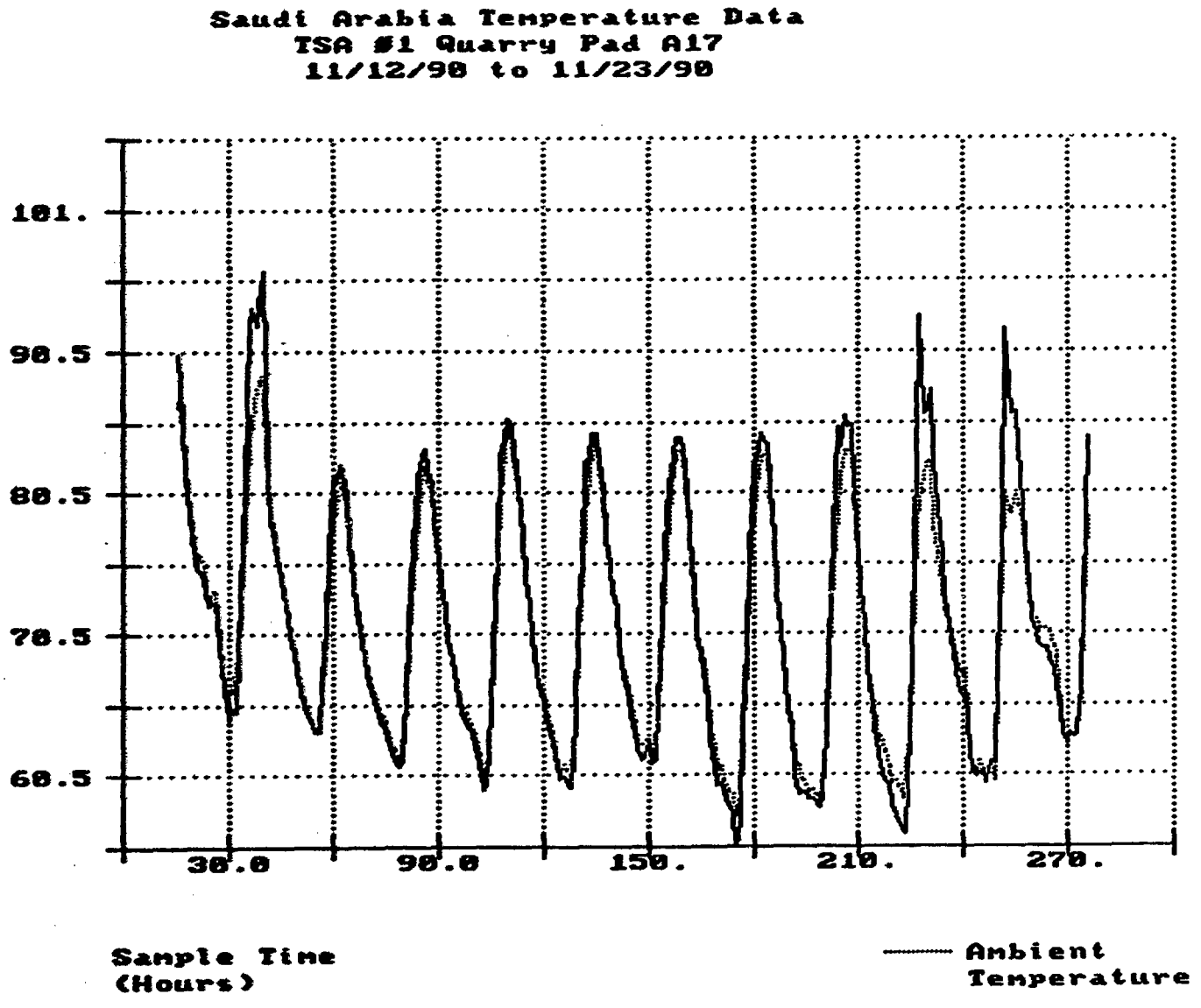
DRAFTSMAN TRS	TITLE TEST No. 3 TEST SITE TSA No. 1 QUARRY
TEST ENGINEER	
CHIEF, VALIDATION ENGINEERING DIVISION	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL, SAVANNA, ILLINOIS 61074-9639

Saudi Arabia Temperature Data
TSA #1 Quarry Pad A17
11/12/90 to 11/23/90



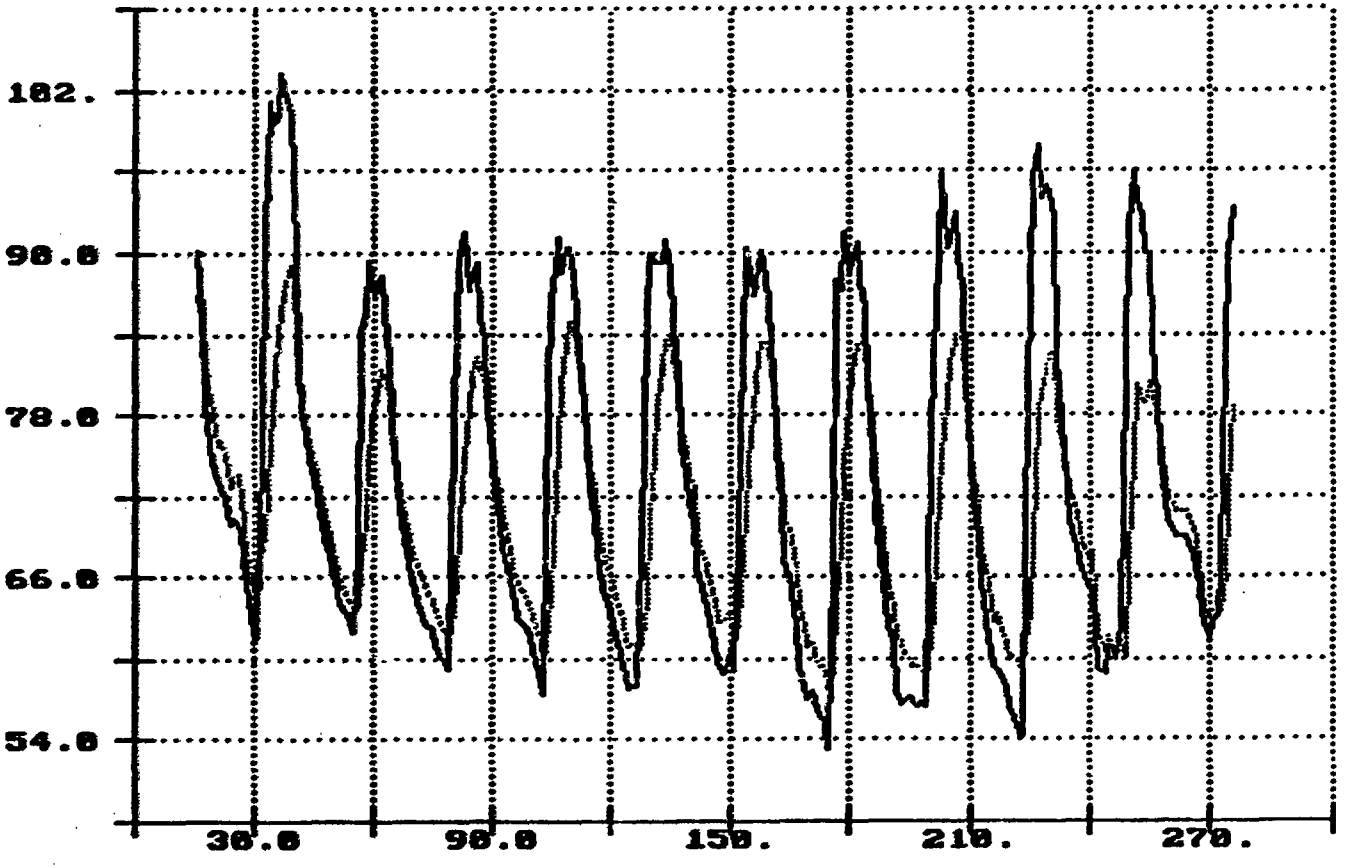
1B: Hellfire, 1410-01-192-8293
Top of Container, SN 606588
(Degrees Farenheit)

Graph 11



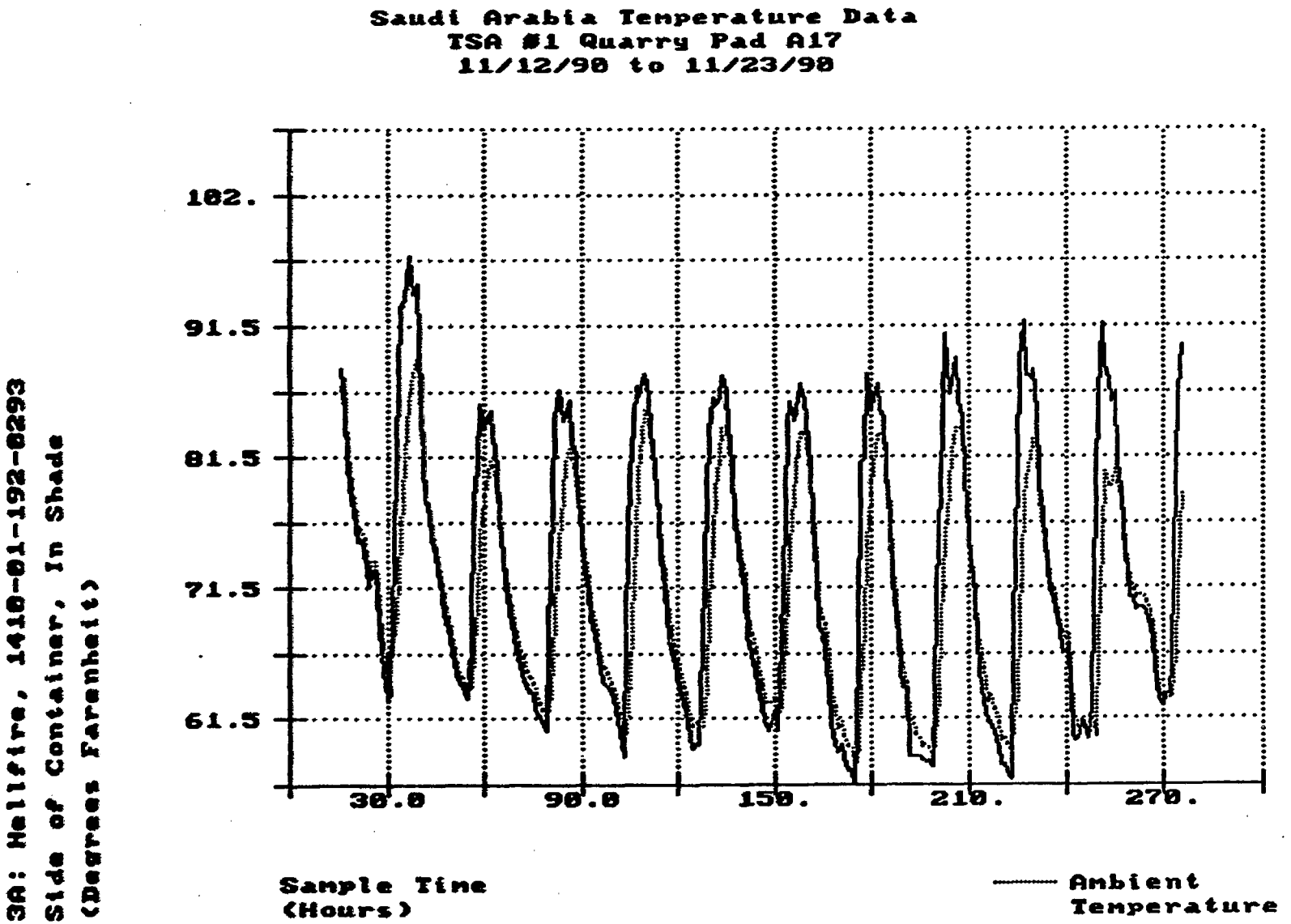
2A: Hellfire, 1410-01-192-0293
Between Containers
(Degrees Farenheit)

Saudi Arabia Temperature Data
ISA #1 Quarry Pad A17
11/12/90 to 11/23/90



2B: Hellfire, 1410-01-192-0293
Side of Container, In Shade, SN 606501
(Degrees Farenheit)

Graph 13


Saudi Arabia Temperature Data
TSA #1 Quarry Pad A17
11/12/90 to 11/23/90
102.
91.5
81.5
71.5
61.5
30.0
90.0
150.
210.
270.
Sample Time
(Hours)
Ambient
Temperature
3A: Hellfire, 1410-01-192-0293
Side of Container, In Shade
(Degrees Farenheit)

TEST RESULTS

D. TEST NO. 4:

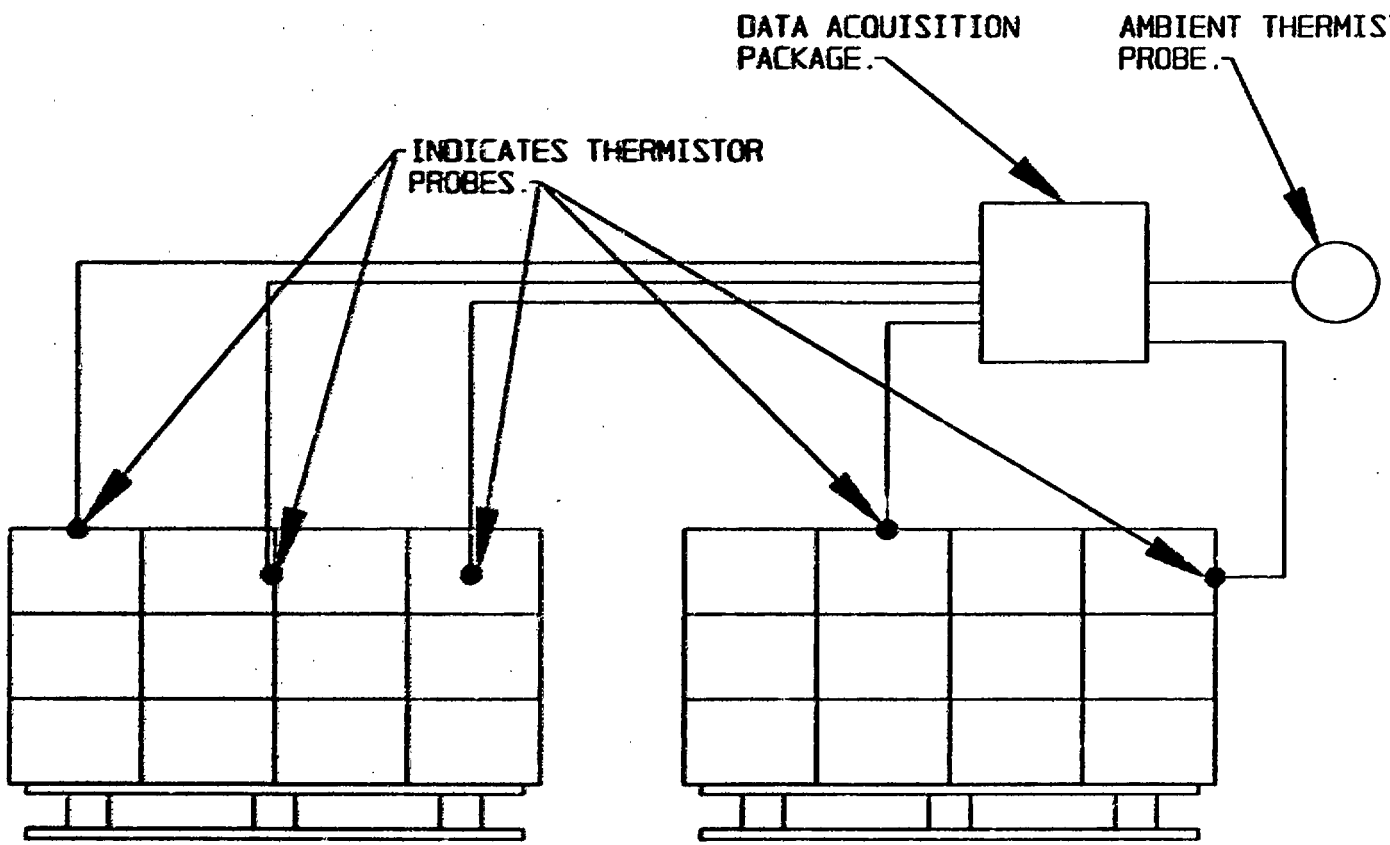
1. This test was conducted 23 November - 4 December 1990 on mechanical time, superquick (MTSQ) fuzes (M577) and 23 November - 10 December 1990 on Proximity fuzes (M732) at the Quarry ASP. During this test, temperature probes were located on the top containers, between the wooden boxes, on both the exposed and shaded sides of the pallet (see test site setup on page 5-29 for details).

2. For the MTSQ fuzes, the temperature probe buried between ammunition boxes had a maximum temperature of approximately 79 degrees Fahrenheit and demonstrated thermal lag (as noted in test no. 3). The probe exposed to the shady side of the pallet reached a maximum of 102 degrees Fahrenheit and exceeded the maximum ambient temperatures of between 5 degrees Fahrenheit and 20 degrees Fahrenheit on a day-to-day basis. This gave some indication of direct sunlight hitting this side of the pallet. For Proximity fuzes, ambient temperatures ranged between 78 degrees Fahrenheit and 85 degrees Fahrenheit during testing. The probe exposed directly to the sun varied between 98 degrees Fahrenheit and 115 degrees Fahrenheit. Probes between pallet boxes remained close to ambient throughout testing with a thermal lag. Notably, this probe never reached the highs or the lows of the daily ambient temperature swings. Probes on top of the pallet reached a maximum temperature of 102 degrees Fahrenheit, or 20 degrees Fahrenheit above ambient on the 12th day of testing.

3. Upon completion of this test, the following observations were formed:

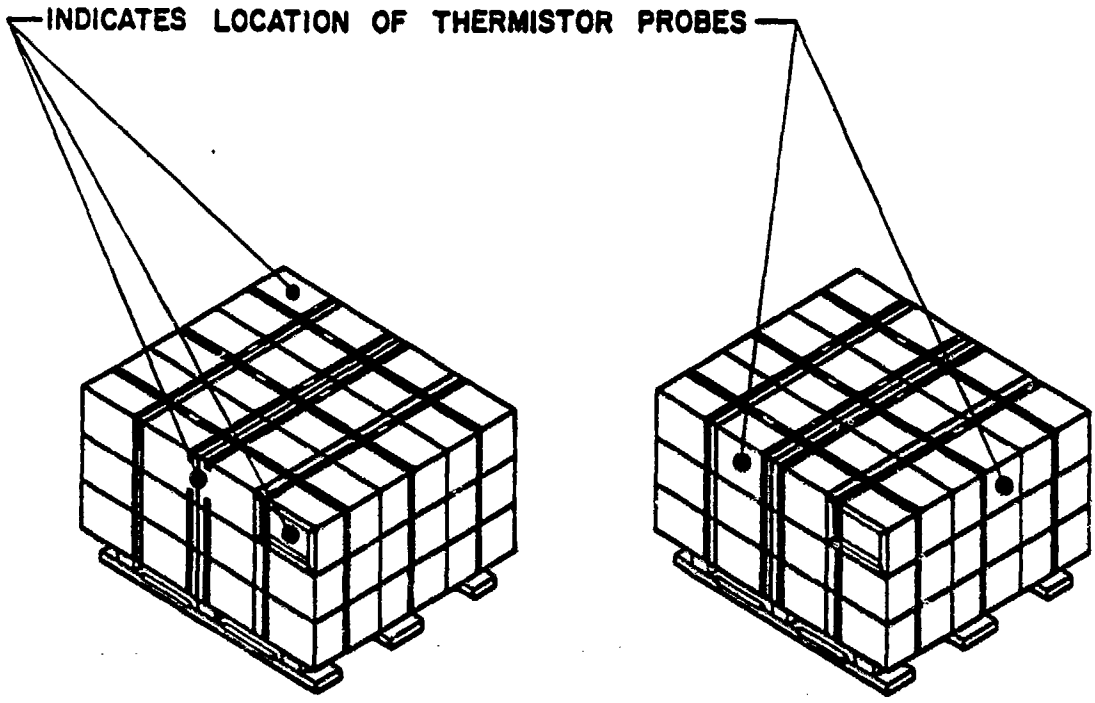
a. Although tests were conducted during the late fall/early winter, temperatures exceeded 100 degrees Fahrenheit on the ammunition items.

b. Probes measuring inside pallet temperatures showed clear thermal lag, not cooling off or warming up as fast as ambient, which is to be expected. However, during summer months this could have an adverse effect on storing heat not dissipated off at night exposing ammunition to longer periods of high temperatures.



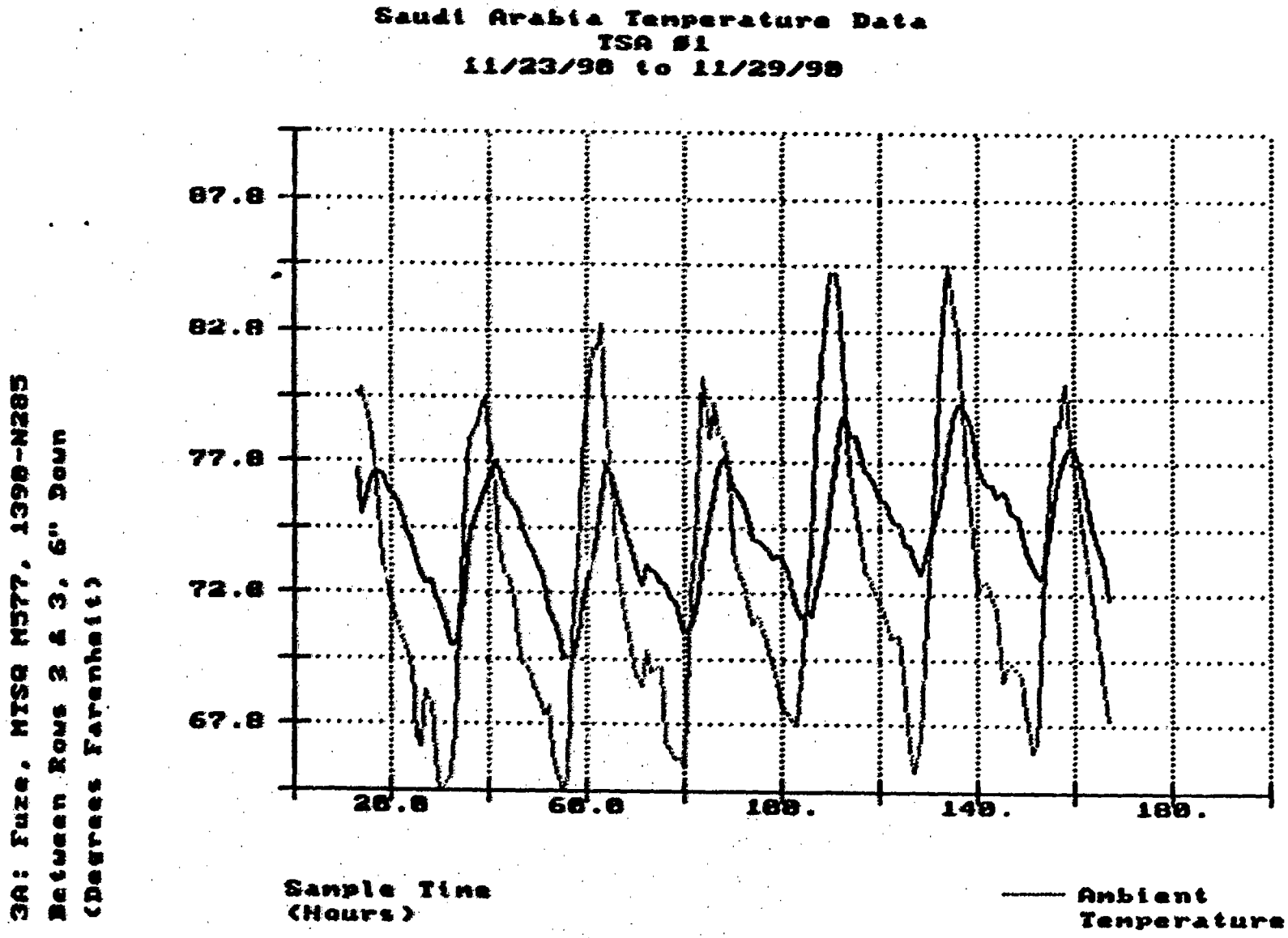
FUZES

TEST NUMBER 4
TEST SITE TSA #1 QUARRY

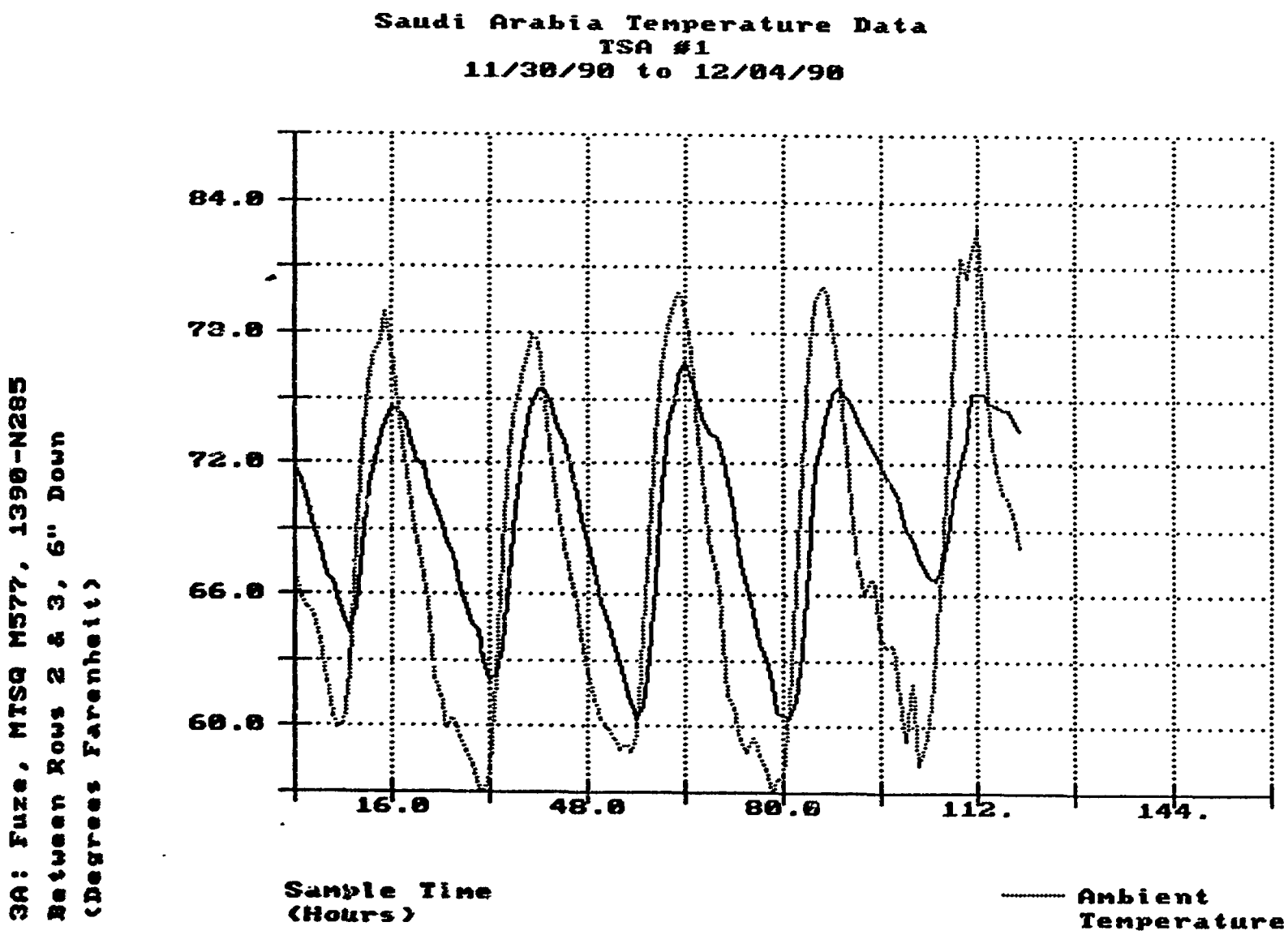


FUZES

DRAFTSMAN TRS	TITLE TEST No. 4 TEST SITE TSA No. 1 QUARRY
TEST ENGINEER	
CHIEF, VALIDATION ENGINEERING DIVISION	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL, SAVANNA, ILLINOIS 61074-9639

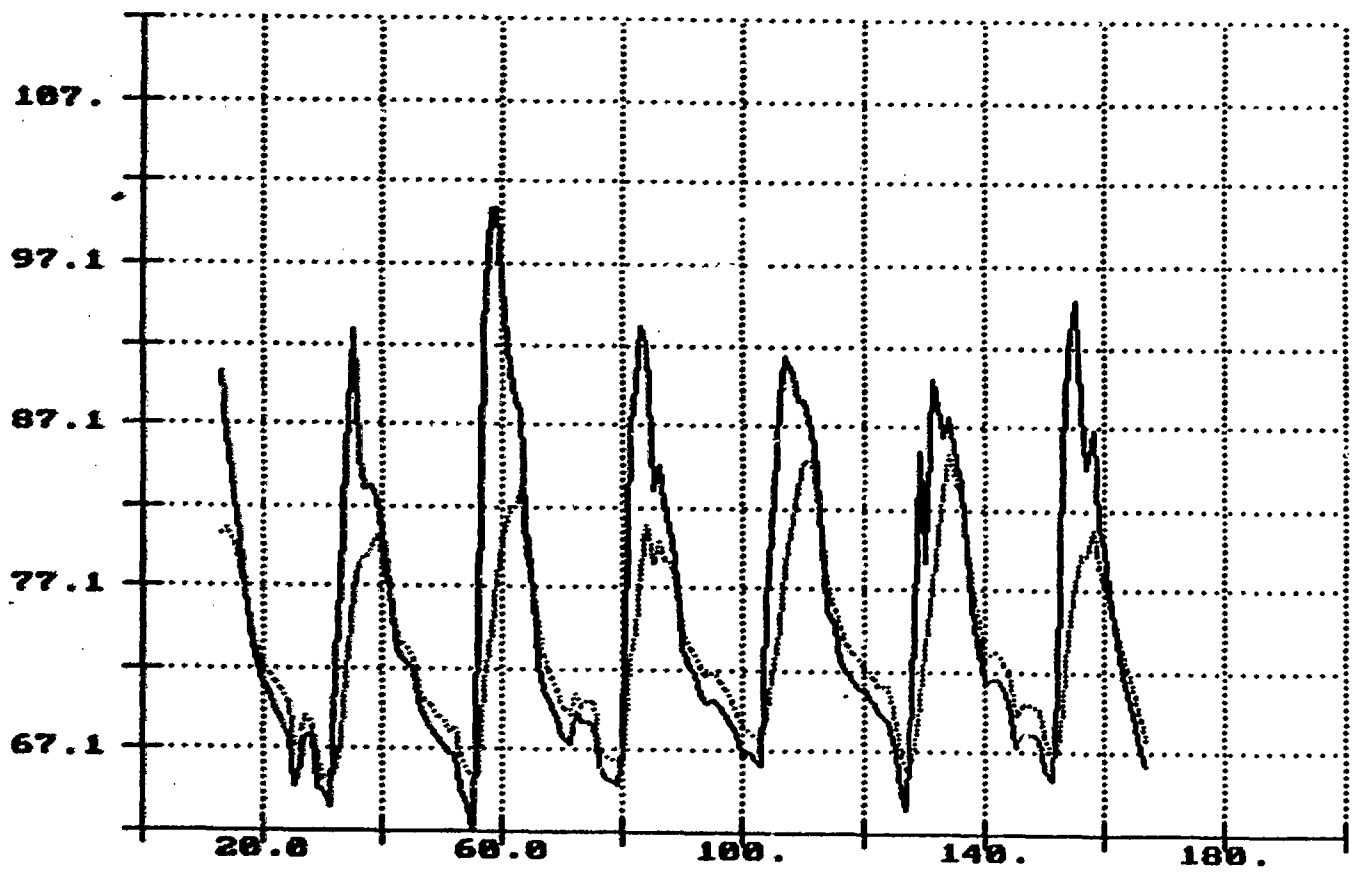

Saudi Arabia Temperature Data
TSA #1
11/23/98 to 11/29/98
87.8
82.8
77.8
72.8
67.8
20.0
60.0
100.
140.
180.
Sample Time
(Hours)
Ambient
Temperature
3A: Fuze, MTSQ M577, 1398-N285
Between Rows 2 & 3, 6" Down
(Degrees Farenhe(t)

Graph 15


Saudi Arabia Temperature Data
TSA #1
11/30/90 to 12/04/90
3A: Fuze, MTSQ M577, 1390-N285
Between Rows 2 & 3, 6" Down
(Degrees Farenheit)
84.0
78.0
72.0
66.0
60.0
16.0
48.0
80.0
112.
144.
Sample Time
(Hours)
Ambient
Temperature

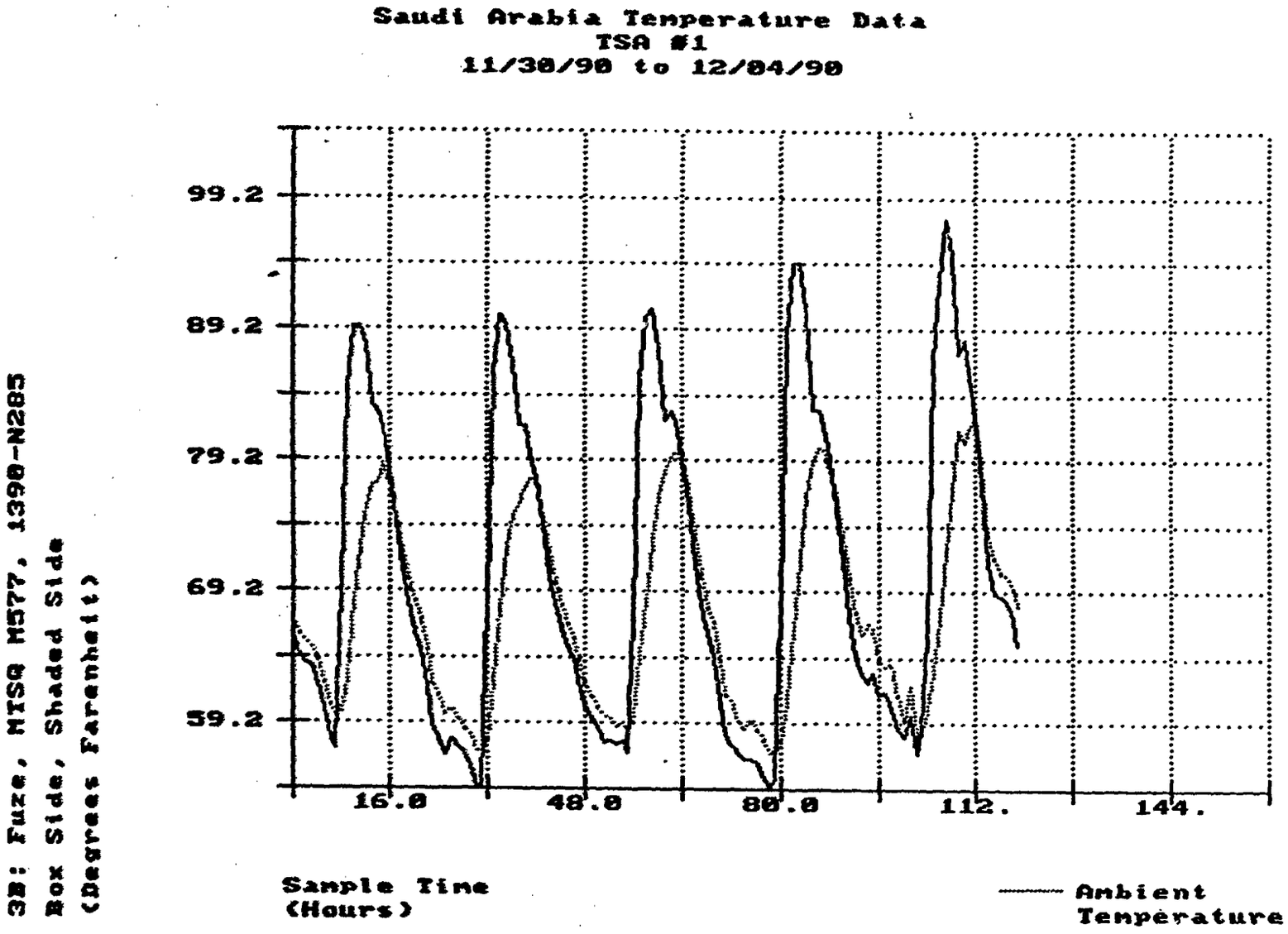
Graph 16

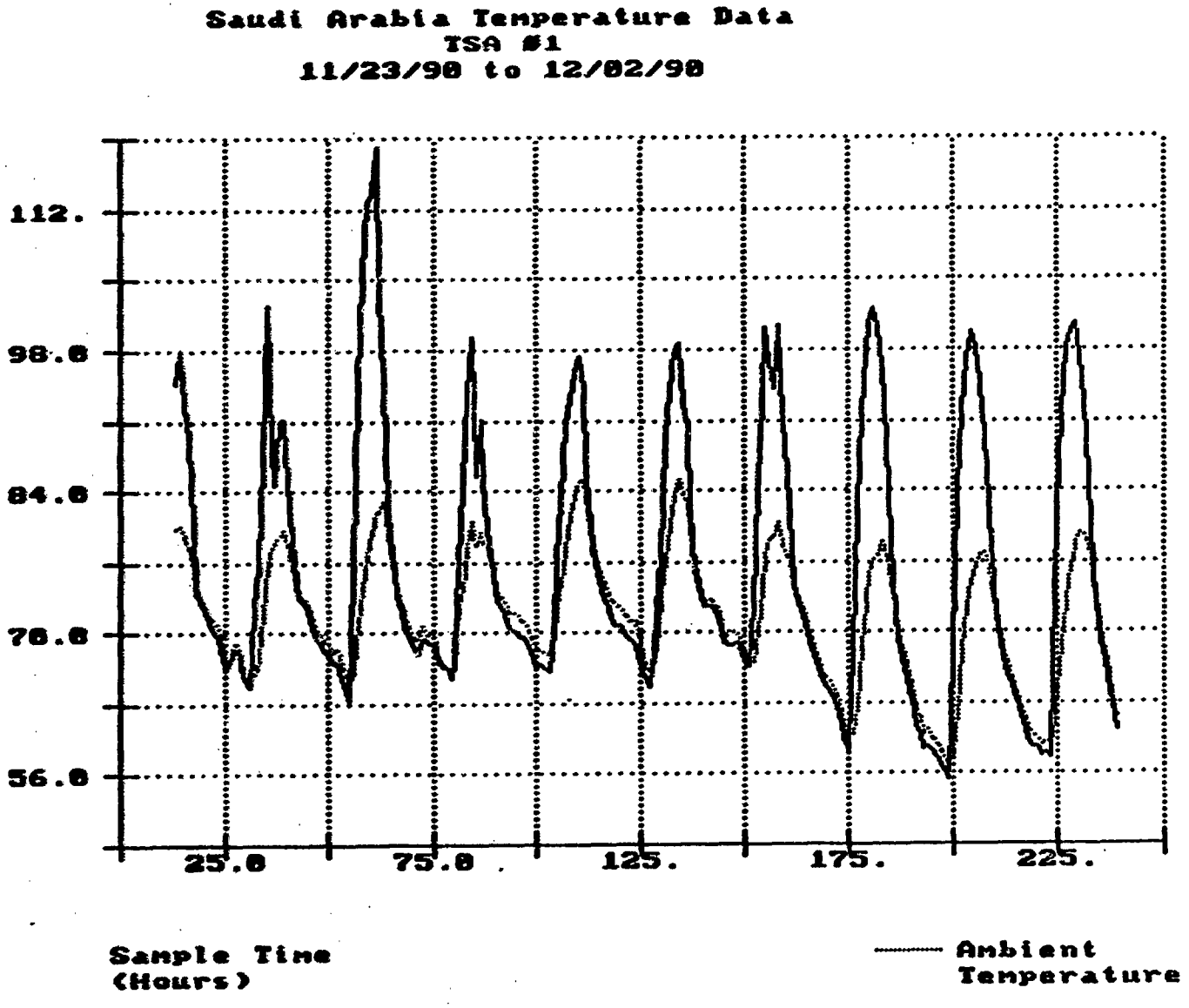
Saudi Arabia Temperature Data
TSA #1
11/23/90 to 11/29/90



3B: Fuze, MTSQ M577, 1390-N285
Box Side, Shaded Side
(Degrees Farenheit)

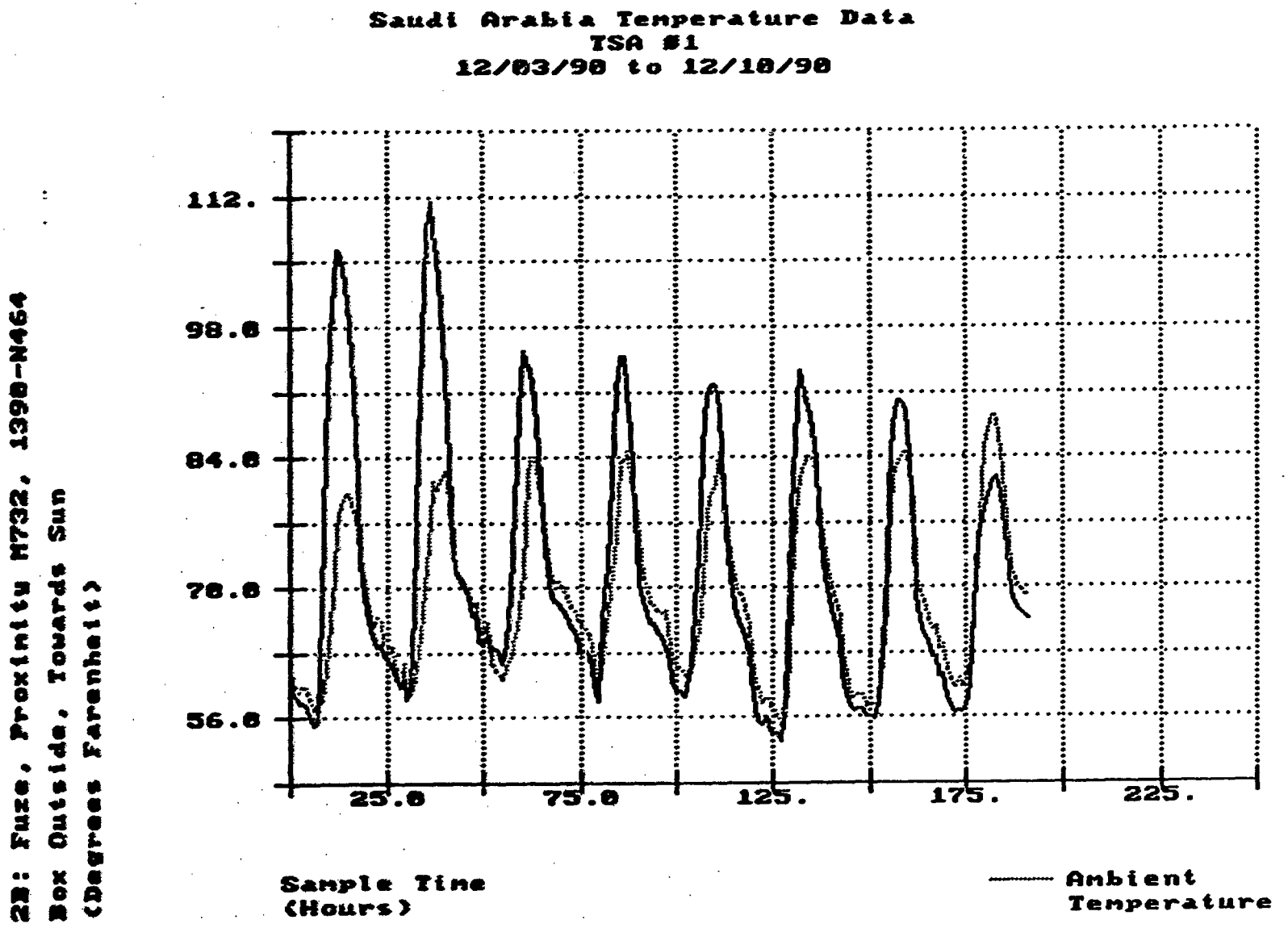
Graph 17


Saudi Arabia Temperature Data
TSA #1
11/30/90 to 12/04/90
99.2
89.2
79.2
69.2
59.2
16.0
48.0
80.0
112.
144.
Sample Time
(Hours)
Ambient
Temperature
3B: Fuze, MTSQ M577, 1300-N285
Box Side, Shaded Side
(Degrees Farenheit)

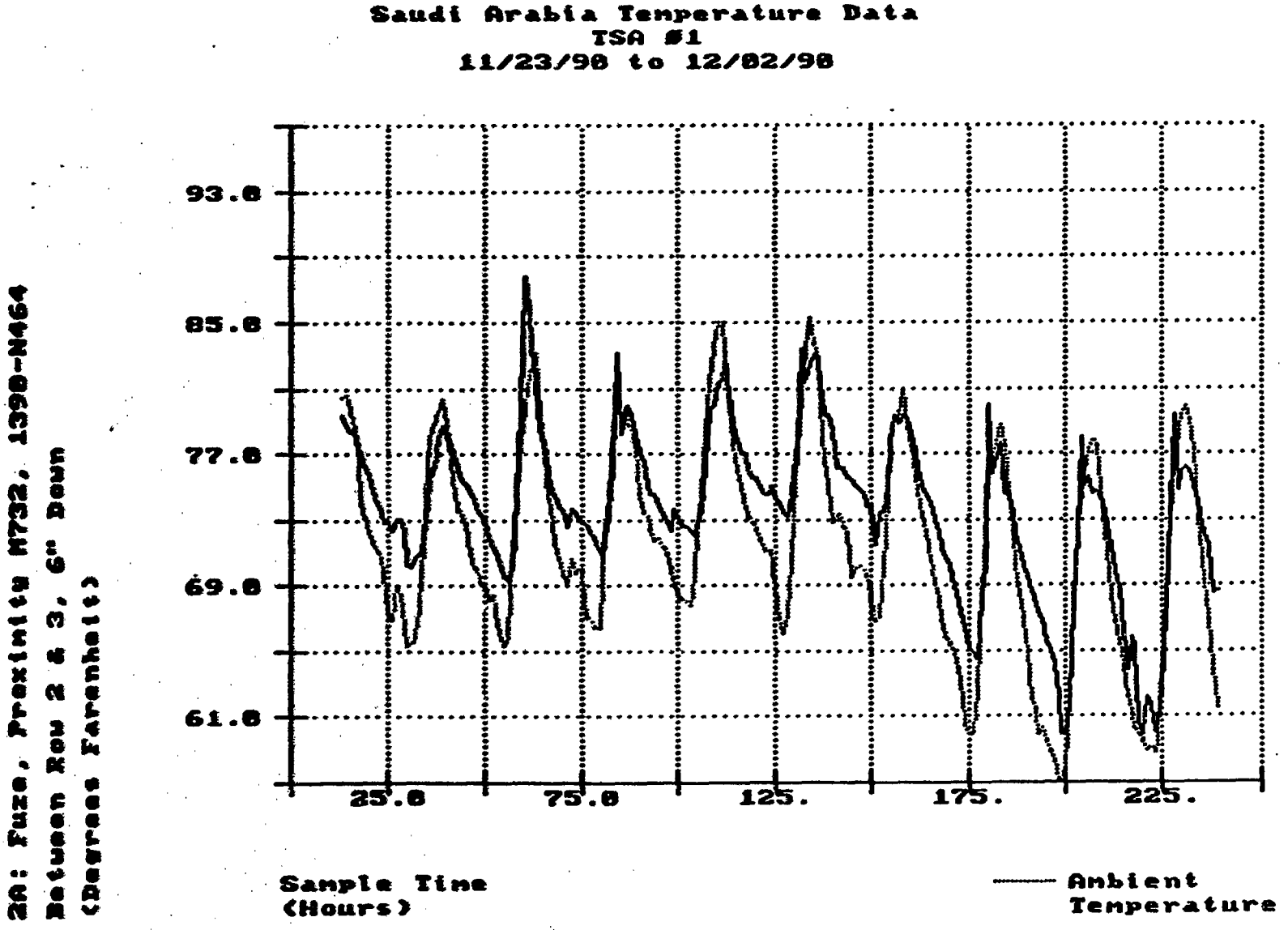


2B: Fuze, Proximity M732, 1390-N464
Box Outside, Towards Sun
(Degrees Farenheit)

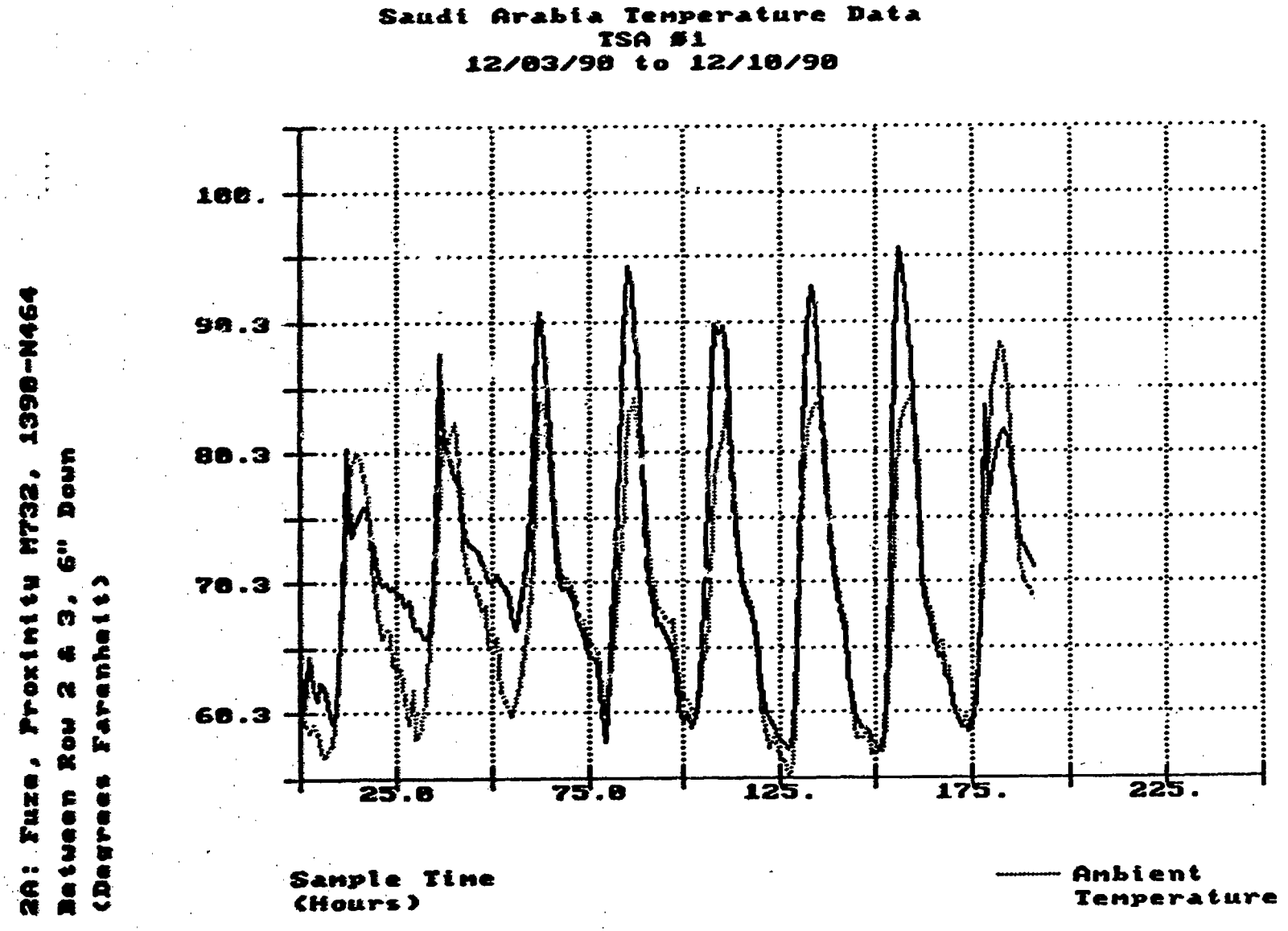
Graph 19



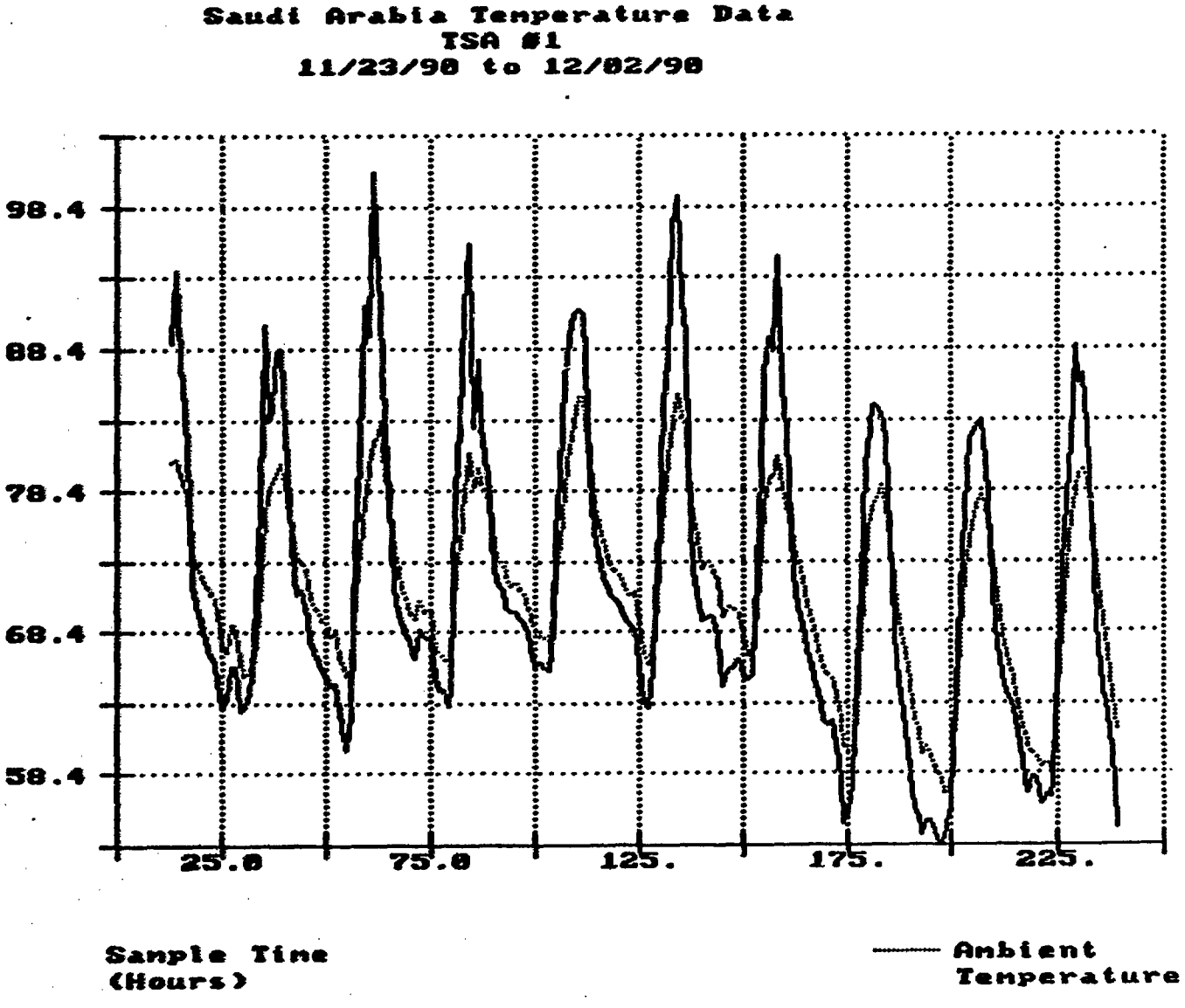
28: Fuze, Proximity M732, 1390-N464
Box Outside, Towards Sun
(Degrees Farenheit)


Saudi Arabia Temperature Data
TSA #1
11/23/98 to 12/02/98
93.0
85.0
77.0
69.0
61.0
25.0
75.0
125.
175.
225.
Sample Time
(Hours)
Ambient
Temperature
20: Fuze, Proximity M732, 1390-N464
Between Row 2 & 3, 6" Down
(Degrees Farenheit)

Graph 21

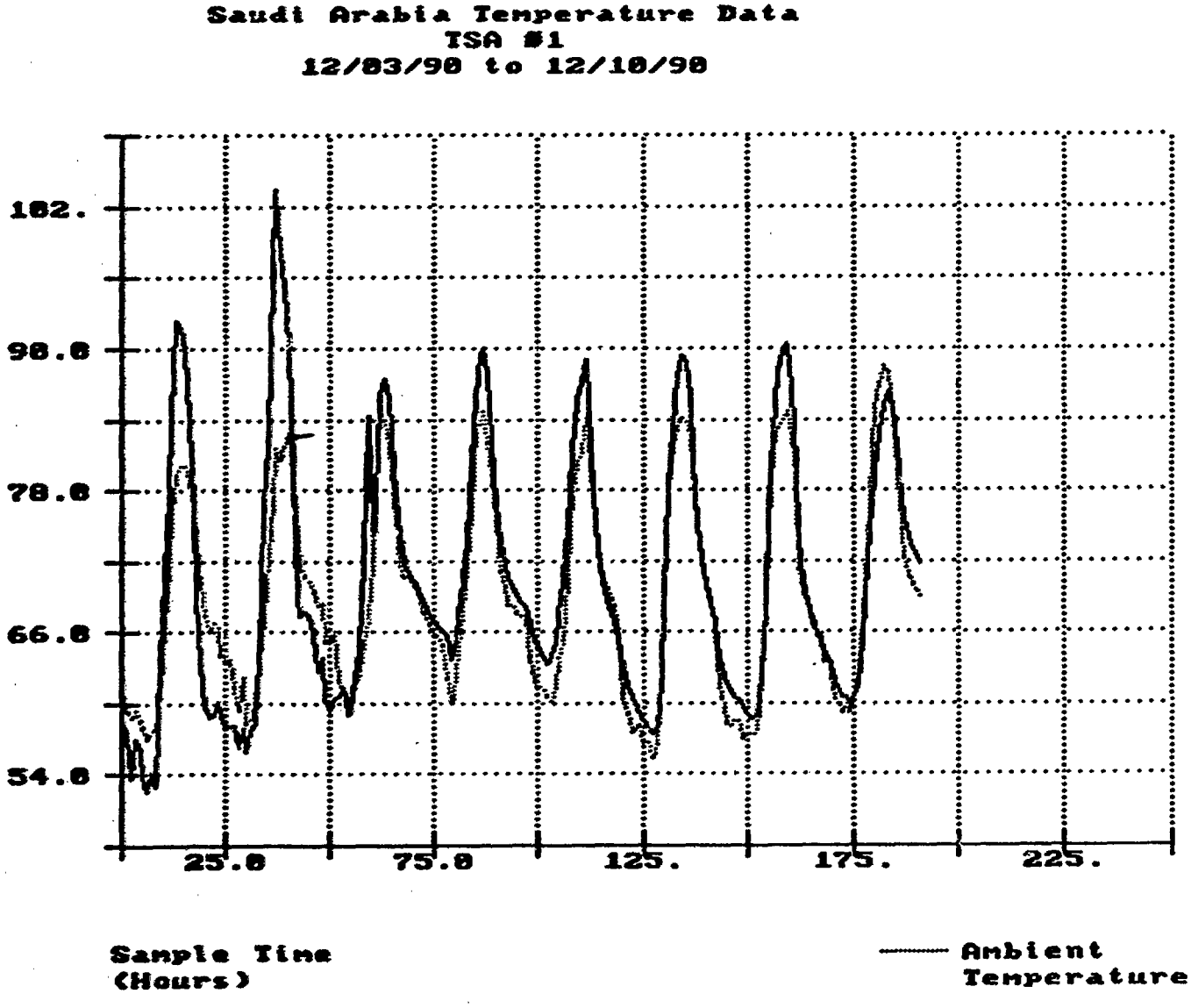

Saudi Arabia Temperature Data
TSA #1
12/03/90 to 12/10/90
100.
90.3
80.3
70.3
60.3
25.0
75.0
125.
175.
225.
Sample Time
(Hours)
Ambient
Temperature
20: Fuze, Proximity M732, 1390-N464
Between Row 2 & 3, 6" Down
(Degrees Farenheit)

Graph 22



1B: Fuze, Proximity M732, 1390-N464
Pallet Top
(Degrees Farenheit)

Graph 23



13: Fuze, Proximity M732, 1390-N464
Pallet Top
(Degrees Farenheit)

PART 6

DISCUSSION

Although the tests in this report were conducted during late fall/early winter and were of short duration, the following insights are possible as to climatic environmental effects on ammunition storage and monitoring programs in SA:

a. Heat damage during this timeframe is highly unlikely if the critical temperature is 160 degrees Fahrenheit or greater. It can be expected that ammunition will exceed 160 degrees Fahrenheit during the summer timeframe, resulting in potential heat damage to the ammunition.

b. Some ammunition appeared to absorb more solar radiation than others with higher skin temperatures. If this observation is correct, critical items should be identified early and monitored first during full scale evaluations.

c. In lieu of protective covering, empty containers/boxes should be used as shielding on the top and sides of pallets to avoid solar radiation. Noteworthy, inner layers remained close to the ambient temperature with little heat transfer.

d. There is no direct correlation between ammunition skin temperature and ambient temperature, it is dependent on such variables as wind speed and direction, length of exposure, cloud cover, amount of particulate in the air, thermal mass of the ammunition, etc.

e. Heat damage to the ammunition cannot be determined by skin temperature probes alone, due to the thermal lag and heat transfer into the rounds. To thoroughly evaluate high temperature effects on ammunition, live ammunition of known condition must have internal thermal couples installed on critical elements in order to monitor true temperature. Safety approval must be granted prior to instrumenting any live ammunition.

PART 7

APPENDIX

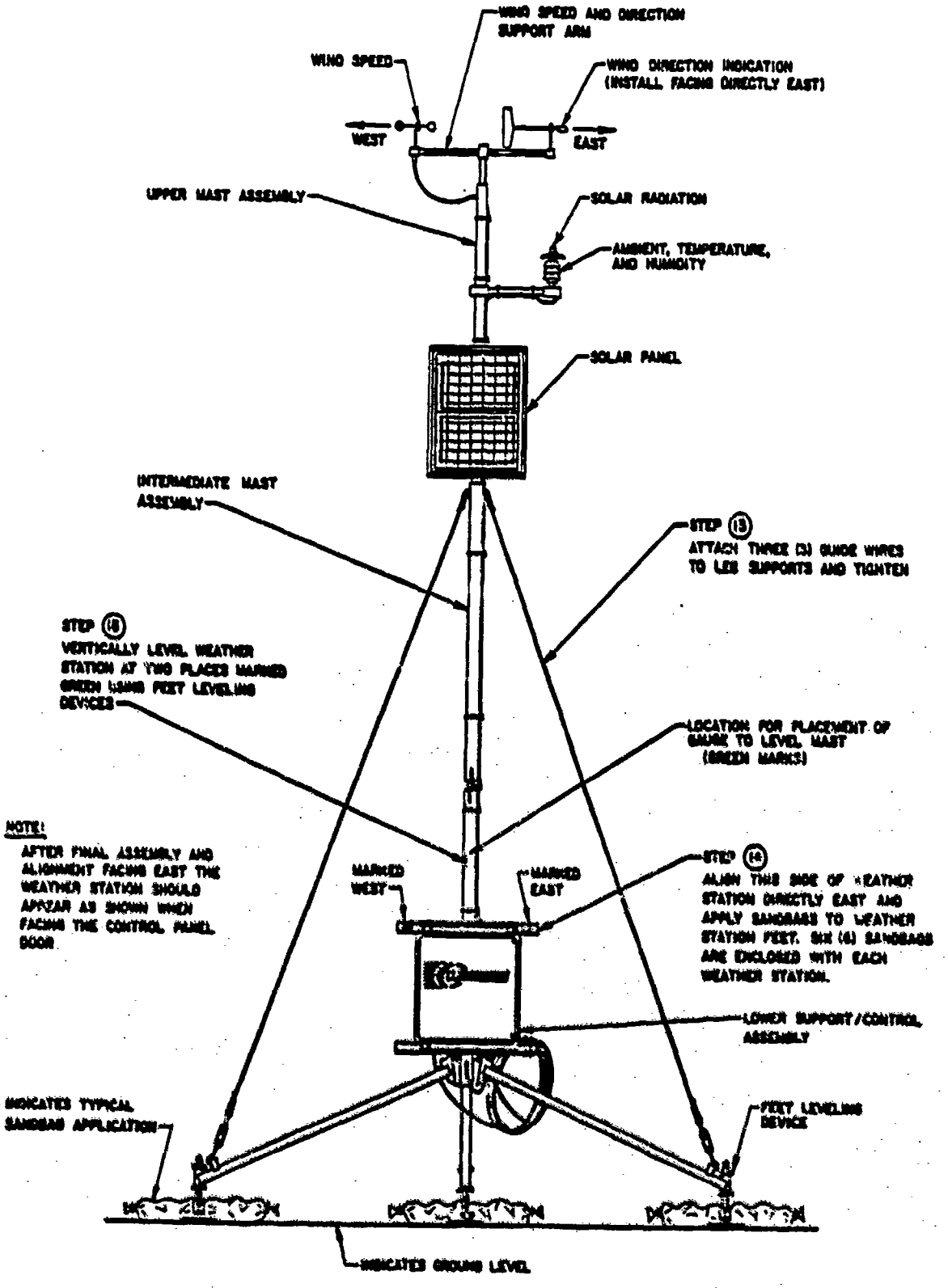
Future items to be tested in SA.

ITEMS TO BE INSTRUMENTED

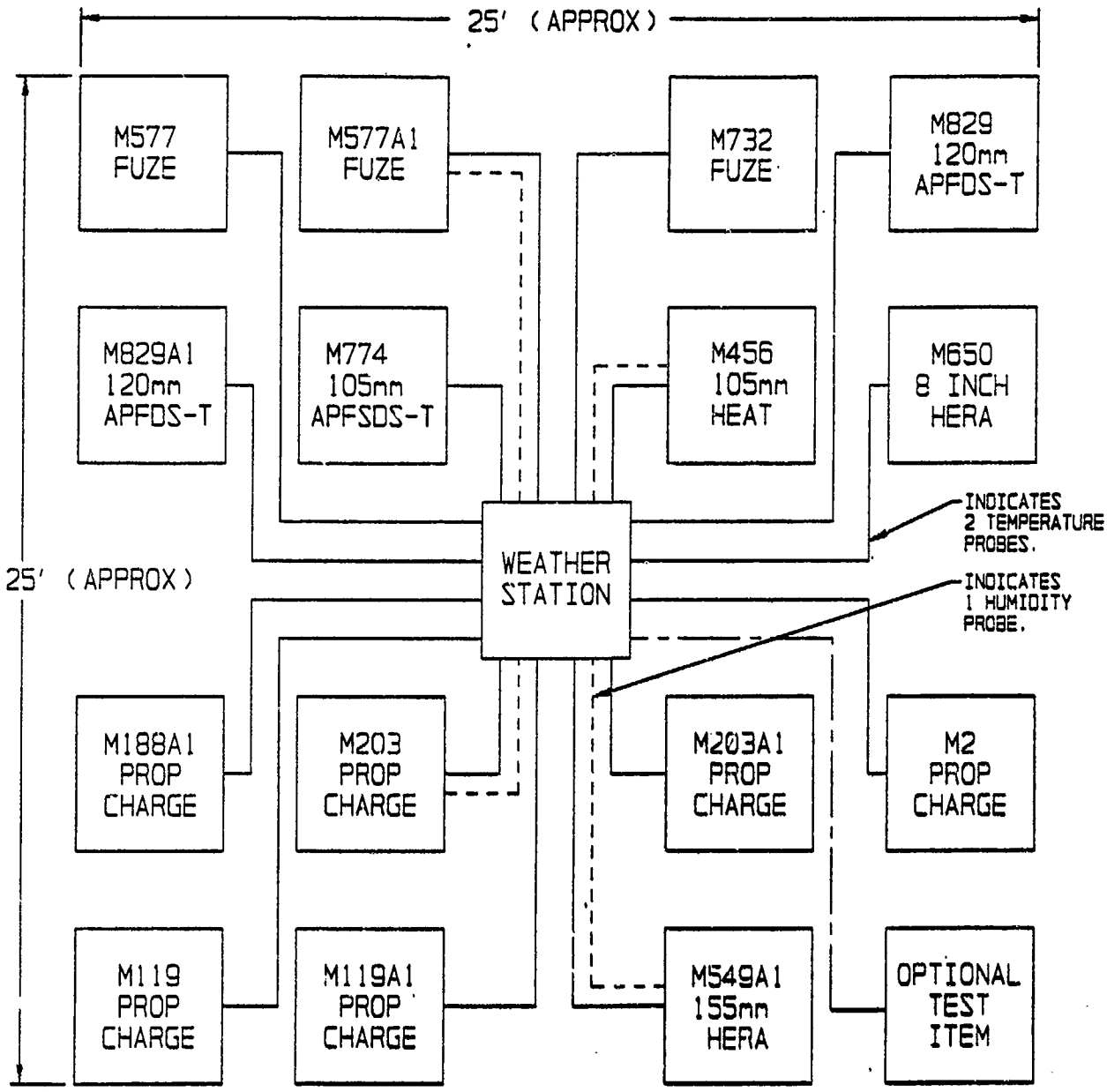
ITEM	DODIC	KNOWN PROBLEM AT HIGH TEMPERATURE
CTG, 120MM APFSDS-T, M829/M829A1	C786	COMBUST. CASE WATER DAMAGE COMBUST. CASE GLUE JOINT PENETRATOR CORROSION
CHG, PROP, 8 INCH WB M188A1	D662	STABILIZER DEPLETION BAG DETERIORATION MELTING WAX
FUZE, MTSQ M577/M577A1	N285	EVAPORATION OF LUBRICANT
CHG, PROP, 155MM M203/M203A1	D532	STABILIZER DEPLETION DAMAGED COMBUST. CART. CASE
CTG, 105MM, HEAT-T, M456	C508	STABILIZER DEPLETION WARHEAD DETERIORATION
CTG, 105MM, APFSDS-T, M774	C523	STABILIZER DEPLETION PENETRATOR CORROSION
PROJ, 8 INCH, HERAP, M650	D624	DELAMINATION OF INHIBITOR CRACKING OF PROPELLANT STABILIZER DEPLETION
CHG, PROP, 155MM, M119/M119A1	D533	STABILIZER DEPLETION BAG DETERIORATION
PROJ, 155MM, HERAP, M549	D579	DELAMINATION OF INHIBITOR CRACKING OF PROPELLANT GRAIN STABILIZER DEPLETION
FUZE, PROX, M732	N464	LEAKING BATTERIES
CHG, PROP, 155MM, GBM3	D540	STABILIZER DEPLETION BAG DETERIORATION

ITEMS TO BE INSTRUMENTED

ITEM	DODIC	KNOWN PROBLEM AT HIGH TEMPERATURE
CTG, 105MM HE, M1	C445	STABILIZER DEPLETION BAG DETERIORATION
PROJ, 155MM, HE APER M483A1	D563	EXPLOSIVE CHARGE STABILITY GRENADE PERFORMANCE BASE STRESS CORROSION CRACKING
MINE, APERS HE M74 (GEMSS)/ AT HE, M75 (GEMSS)	K151/K184	CORROSION OF FUZES CAPACITOR PROBLEM
CTG, 60MM SMK, M302A1	B630	MELTING WP STABILIZER DEPLETION
CTG, 4.2 INCH SMK, M328A1	C708	MELTING WP STABILIZER DEPLETION
CTG, 81MM HE, M374A3	C256	IGNITION CARTRIDGE SENSITIVITY STABILIZER DEPLETION
GRENADE, HAND, FRAG M67	G881	SHORT FUZE TIME
CTG, 81MM HE, M821	C868	HIGH TEMP. PERFORMANCE CONCERN STABILIZER DEPLETION
CTG, 4.2 INCH HE, M329A2	C697	HIGH TEMP. PERFORMANCE CONCERN STABILIZER DEPLETION OBTURATOR 'GROWTH'
CTG, 60MM HE, M494A	B632	HIGH TEMP. PERFORMANCE CONCERN
CTG, 60MM ILLUM, M83A3	B627	HIGH TEMP. PERFORMANCE CONCERN FUNCTIONING DEFECTS
CTG, 4.2 INCH HE, M329A1	C705	HIGH TEMP. PERFORMANCE CONCERN STABILIZER DEPLETION
M888, 60MM, HE	B643	STABILIZER DEPLETION
155MM COPPERHEAD PROJECTILE	M712	HIGH COST PROJECTILE



DRAFTSMAN TRS	TITLE **WEATHER STATION**
TEST ENGINEER	**ASSEMBLY DRAWING – PAGE 3 of 3**
CHIEF, VALIDATION ENGINEERING DIVISION	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL, SAVANNA, ILLINOIS 61074-9639



WEATHER STATION

1. SOLAR RADIATION.
2. AMBIENT TEMPERATURE.
3. AMBIENT HUMIDITY.
4. WIND SPEED.
5. WIND DIRECTION.

TEST ITEM

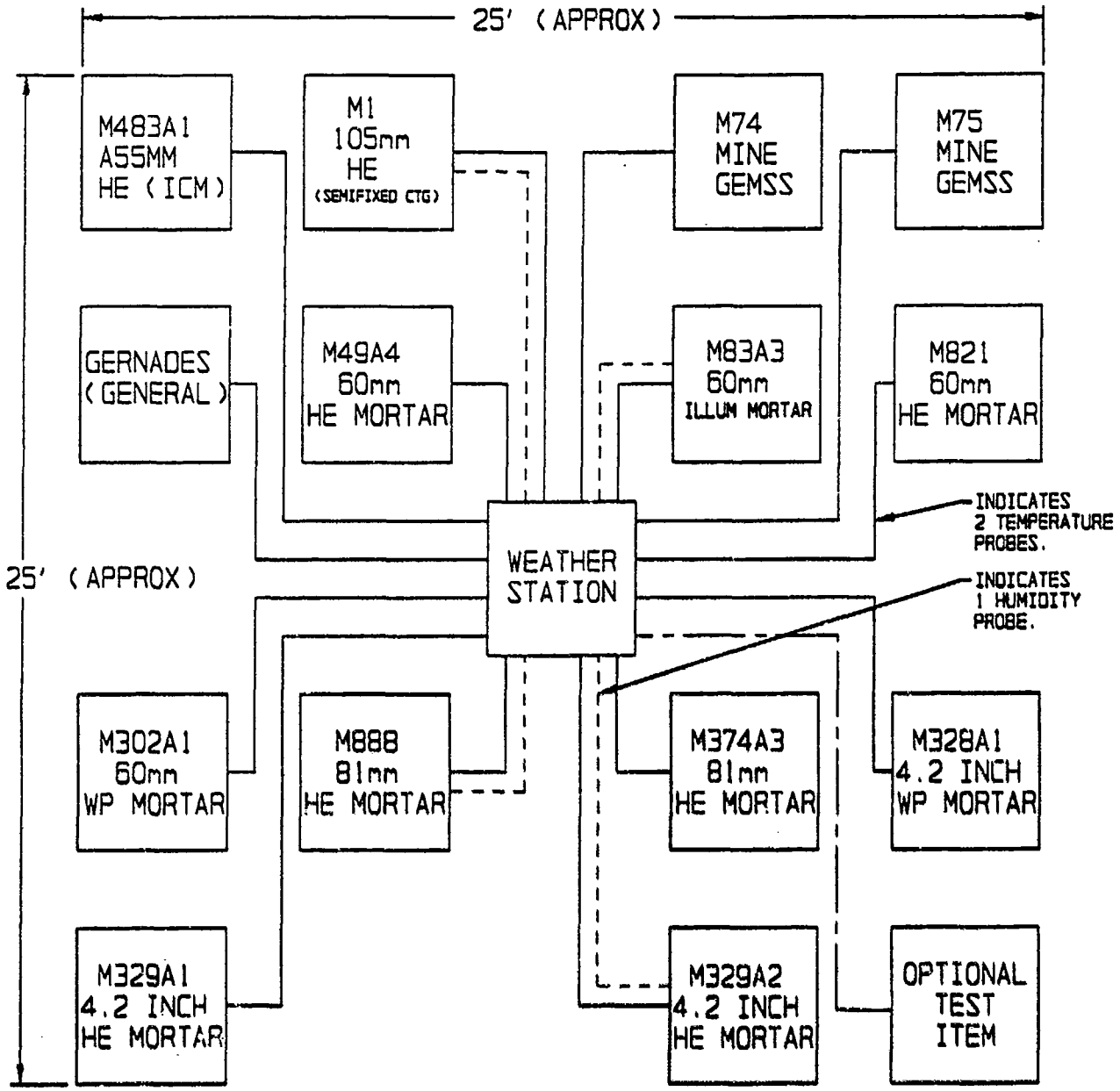
1. 1 PALLET EACH.
2. 2 TEMPERATURE PROBES.
   a. SHIPPING CONTAINER
   b. ITEM
3. RANDOM HUMIDITY CHECKS.

NOTES:

1. 37-CHANNEL DATA AQUISITION.
2. WIRE HARNESS INSTALLATION.
   a. (2-6 CHANNEL CABLE)
   b. (2-10 CHANNEL CABLE)
3. WIRE LENGTHS (APPROX).
   a. 8 AT 25 FOOT
   b. 8 AT 50 FOOT
   c. 8 AT 75 FOOT
   d. 8 AT 100 FOOT

FOR INFORMATION ONLY

TITLE	DWG NO
USADACS INSTRUMENTATION SITE PLAN (TYPICAL)	90-033-0-S00007
	VALIDATION ENGINEERING DIVISION — SHEET 1 OF 5



WEATHER STATION

1. SOLAR RADIATION.
2. AMBIENT TEMPERATURE.
3. AMBIENT HUMIDITY.
4. WIND SPEED.
5. WIND DIRECTION.

TEST ITEM

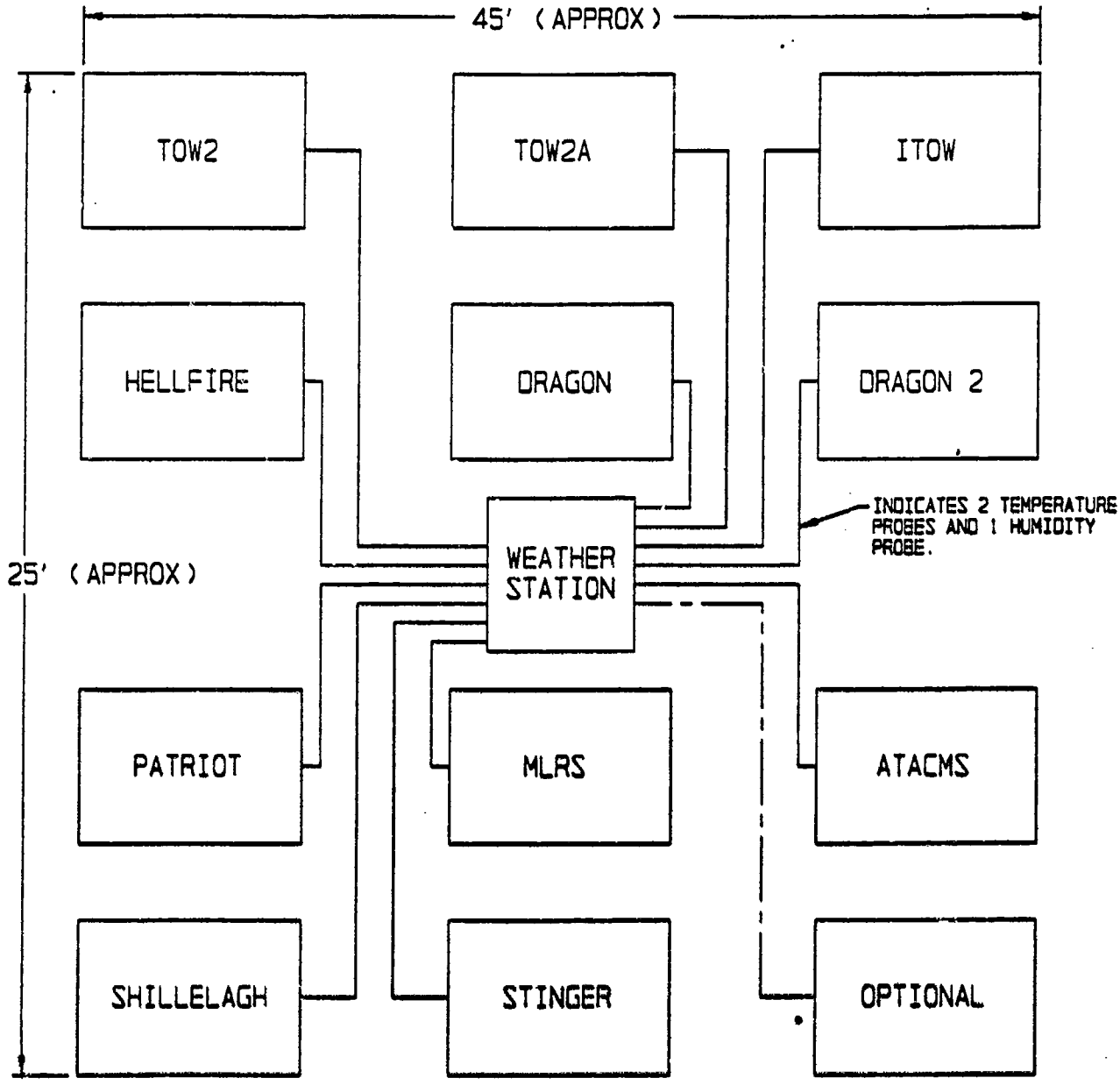
1. 1 PALLET EACH.
2. 2 TEMPERATURE PROBES.
   a. SHIPPING CONTAINER
   b. ITEM
3. RANDOM HUMIDITY CHECKS.

NOTES:

1. 37-CHANNEL DATA AQUISITION.
2. WIRE HARNESS INSTALLATION.
   a. (2-6 CHANNEL CABLE)
   b. (2-10 CHANNEL CABLE)
3. WIRE LENGTHS (APPROX).
   a. 8 AT 25 FOOT
   b. 8 AT 50 FOOT
   c. 8 AT 75 FOOT
   d. 8 AT 100 FOOT

FOR INFORMATION ONLY

TITLE	DWG NO
USADACS INSTRUMENTATION SITE PLAN (TYPICAL)	90-033-0-S00008
	VALIDATION ENGINEERING DIVISION | SHEET 2 OF 5



WEATHER STATION

1. SOLAR RADIATION.
2. AMBIENT TEMPERATURE.
3. AMBIENT HUMIDITY.
4. WIND SPEED.
5. WIND DIRECTION.

TEST ITEM

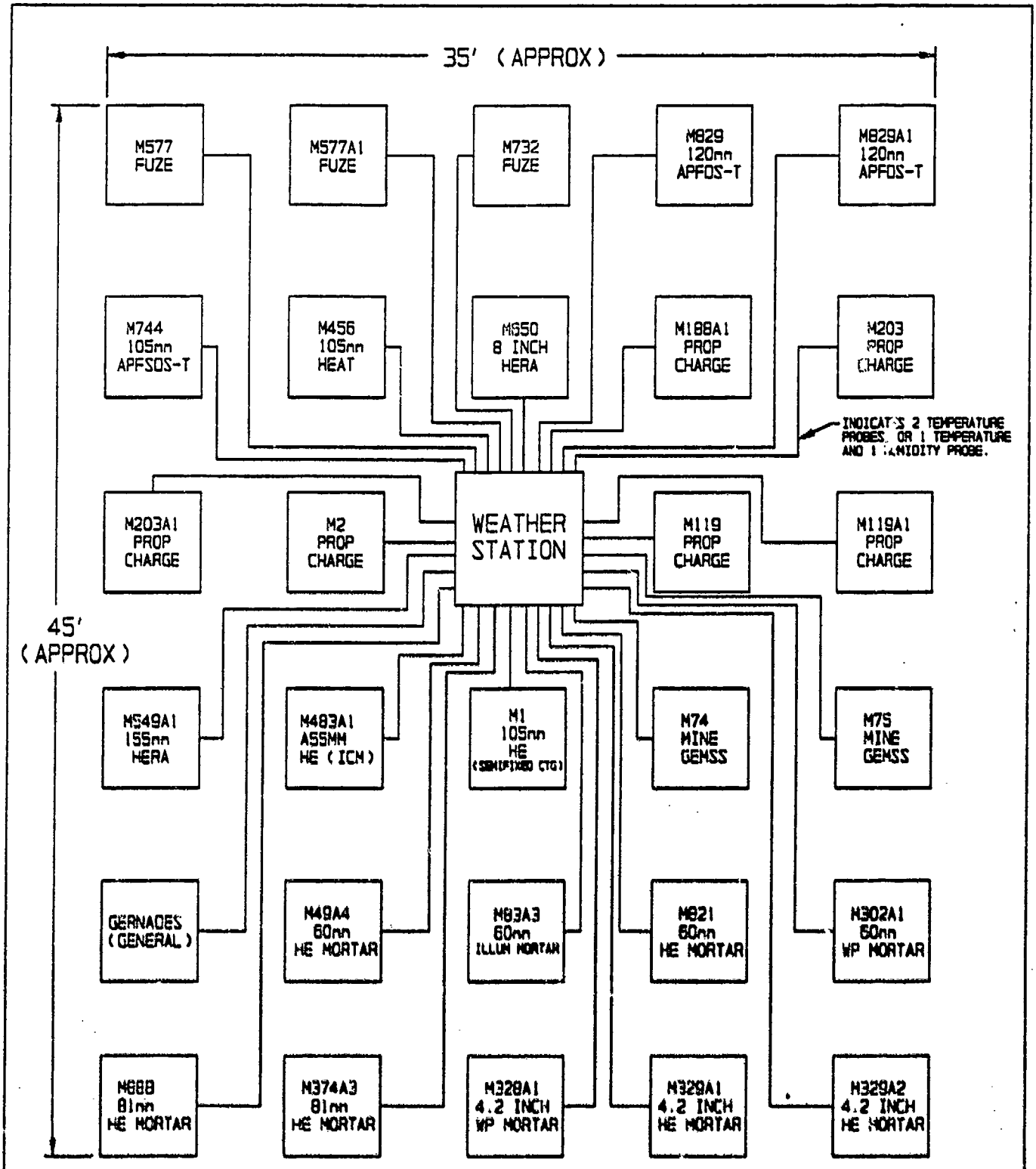
1. 1 SHIPPING/STORAGE CNTR. EACH.
2. EACH ITEM INSTRUMENTED.
   a. EXTERIOR SKIN TEMPERATURE.
   b. MISSILE SURFACE TEMPERATURE.
   c. INTERIOR HUMIDITY.

NOTES:

1. 37-CHANNEL DATA AQUISITION.
2. WIRE HARNESS INSTALLATION.
   a. (2-16 CHANNEL CABLE)
3. WIRE LENGTHS (APPROX).
   a. 8 AT 25 FOOT
   b. 8 AT 50 FOOT
   c. 8 AT 75 FOOT
   d. 8 AT 100 FOOT

FOR INFORMATION ONLY

TITLE	DWG NO	
USADACS INSTRUMENTATION SITE PLAN (TYPICAL) MICOM ITEMS	90-033-0-S00009	
	VALIDATION ENGINEERING DIVISION	SHEET 3 OF 5



NOTE: REPRESENTS UPGRADED 69 CHANNEL WEATHER STATIONS

FOR INFORMATION ONLY

TITLE	DWG NO
USADACS INSTRUMENTATION SITE PLAN (TYPICAL)	90-033-0-S00010
	VALIDATION ENGINEERING DIVISION — SHEET 4 OF 5